Hi-Desert Water District

Water Reclamation Facility
Preliminary Design Report

Volume 1 – Report

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MWH
BUILDING A BETTER WORLD

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January 6, 2009

Hi-Desert Water District
55439 29 Palms Highway
Yucca Valley, CA 92284

Attention: Mr. Joseph Glowitz
District Engineer

Subject: Water Reclamation Facility
Preliminary Design Report

Dear Mr. Glowitz:

MWH is pleased to submit this finalized Preliminary Design Report for the Hi-Desert Water Reclamation Facility in accordance with Task Order WW-07-03. This report has been revised to address comments from the Value Engineering process and the Wastewater Public Advisory Committee. This report includes the following: descriptions of the project background and anticipated performance requirements, a review of available technologies and the most promising biological treatment technologies, descriptions of the unit processes and site development, the anticipated cost and construction schedule, and project implementation constraints.

The review of the biological treatment technologies described in Section 4 did not show a significant difference between the two most promising configurations. Based on the District staff plans for an alternative delivery method to complete the treatment plant construction, the choice between competing technologies can be based on actual bid prices from equipment suppliers and contractors. Section 8 was added to the finalized report to address items of note for the alternative delivery procurement.

To complete this report, we have described the same technologies selected for the previously-planned facility off Avalon Avenue near Paradise Valley, with the exception that UV disinfection will be used instead of chlorination to avoid the formation of disinfection by-products. Thus, this report represents a baseline for the design of the facility.

Sincerely,

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Section 1
Background and Objectives

The Hi-Desert Water District (District) provides water service for the town of Yucca Valley and nearby areas that depend entirely on septic tanks and leach fields for disposal of wastewater. The Colorado River Basin Regional Water Quality Control Board (RWQCB) believes leachate from the septic tank systems is the cause of groundwater quality degradation in the area. They are requiring that a wastewater collection, treatment and disposal system be constructed. As a result, the District is currently in the process of implementing a program to construct and operate the required facilities. The Water Reclamation Facility (WRF) addressed in this report is one component of that program. Other reports that are being prepared include a Sewer System Master Plan, environmental studies, financing plans, and a Title 22 engineering report.

1.1 PROJECT BACKGROUND

The District intends to initially sewer the central portion of the town to convey an annual average flow of 1 million gallons per day (mgd) of wastewater to the WRF currently discharged to septic tanks. The area has been chosen due to its higher density and potentially greater impact on potable water supply wells. This initial project is referred to as Phase 1. In the future, if the Phase 1 facilities do not adequately protect the groundwater quality, or if the RWQCB requires more areas to be sewered, the collection, treatment and disposal facilities will be expanded to collect an additional 1 mgd of sewage. The additional facilities are referred to as Phase 2 facilities. Likewise, Phase 3 facilities will collect an additional 2 mgd wastewater flow for a total system capacity of 4 mgd. Ultimate buildout in the Yucca Valley service area could be as high as 6 mgd, but that would not occur until the distant future. If a wastewater collection system is required in the Yucca Mesa portion of the District's service area in the future, the assumption has been made that that would be treated at a separate facility in the Yucca Mesa area.

The District depends entirely on wells for water supply. Because the natural yield of the groundwater basin is substantially less than demands, the District purchases State Water Project water from the Mojave Water Agency to supplement groundwater through recharge basins. The two primary sources of water to the groundwater basin in the area, therefore, are the imported water and leachate from septic tanks. Because much of the wastewater will now be diverted to the new WRF rather than septic tanks, the District has decided that all treated effluent will be diverted to groundwater recharge. There will be no direct reuse of recycled water.

1.2 OBJECTIVES

The following are the key objectives of District’s wastewater program:

1. Construct a wastewater collection system to reduce the quantity of leachate from septic tank systems flowing into aquifers used for the District’s potable water supply.

2. Treat wastewater to a level such that percolated effluent will not degrade groundwater quality.

3. Provide the core infrastructure for expansion of the collection, treatment and disposal system as needed either to further protect groundwater, or to accommodate growth in the District's service area.

4. Maximize the total water supply available to the District.

5. Minimize any adverse economic and environmental impacts on the community.

In addition, specific objectives for the Phase 1 treatment facilities are as follows:

1. Provide sufficient treatment capacity to ensure continuous compliance with anticipated regulatory requirements for an average annual wastewater flow of 1 mgd.

2. Provide for future expansion of the plant to an annual average flow capacity of 6 mgd.

1.3 REPORT CONTENTS

This report consists of eight sections as discussed below:

- Section 1 – Background and Objectives
- Section 2 – Performance Requirements: This Section describes the assumptions for the equivalent population served by the plant, the influent loading characteristics, treatment requirements, and solids disposal requirements.
- Section 3 – Initial Technology Screening: This Section discusses initial screening of alternative technologies and configurations to identify which warrant additional evaluation. Screening was conducted for the system-wide configuration, biological treatment, disinfection, solids handling, power supply, and structural configurations.
- Section 4 – Technology Evaluation: This Section compares the treatment alternatives identified in Section 3 in more detail, and identifies the preferred alternative.
- Section 5 – Unit Process Development: This Section consists of 14 technical memoranda describing each unit process and support facility.
- Section 6 – Site Development: This Section addresses the site layout and hydraulic profile through the plant.
- Section 7 – Construction Cost: This Section includes the anticipated construction cost for the proposed project.
- Section 8 - Project Implementation: This section describes how this report could be used as the basis for an alternative project delivery process.

Section 2
Performance Requirements

Appropriate sizing and configuration of the treatment plant requires that performance requirements be defined. Definition of performance requirements include establishing the equivalent service area population, wastewater flow rates, hydraulic peaking factors, wastewater characteristics, treatment standards, and solids disposal requirements

2.1 INFLUENT LOADING ASSUMPTIONS

2.1.1 Service Area Population Assumptions

As described in Section 1, the objective of the Phase 1 wastewater facilities is treat flows that average 1 mgd over the course of a year. Phase 2 and Phase 3 facilities will expand the plant capacity to an average annual flow of 2 mgd and 4 mgd, respectively.

While these flow criteria define the hydraulic capacity of the treatment plant, they do not define the waste load in that flow. An effective way of characterizing the waste load is in stating the pounds of biochemical oxygen demand (BOD) in the influent flow. The pounds of waste load, or mass loading rate, on a plant depends on two factors: the hydraulic flow rate, which is defined for this project, and the waste concentration of the flow, which is not. Unfortunately, average influent BOD_5[a] concentrations for similar facilities range widely from 250 mg/L to over 400 mg/L. Influent concentrations are particularly important because they have a direct effect on the size and capacities of certain unit processes, and as a result, on the cost of the facility.

While influent concentrations vary substantially among plants, the mass loading rate per person, however, does not. The approach for defining the capacity of this plant, therefore, is to define the population equivalent[b] in the service area, and then use typical per-capita waste loading rates to define the total mass loading rate. This approach requires an assumption for the per-capita hydraulic flow rate to translate the 1 mgd capacity into a population equivalent service area. A low per-capita flow assumption results in a high population equivalent, which requires higher unit process capacities in the plant. A high per-capita flow assumption results in a low population equivalent, which requires lower unit process capacities in the plant. **Figure 2-1** illustrates the impact of different per-capita flow rate assumptions on the population equivalent rating of the plant.

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[a] BOD_5 is the amount of biochemical demand exerted during a 5-day test. BOD_5 is the standard unit used to quantify BOD.

[b] The term population equivalent is used because part of the load comes from non-residential sources. On a system as a whole, the typical per-capita unit waste production values include non-residential source loads. For the town of Yucca Valley, non-residential loads are almost entirely commercial.

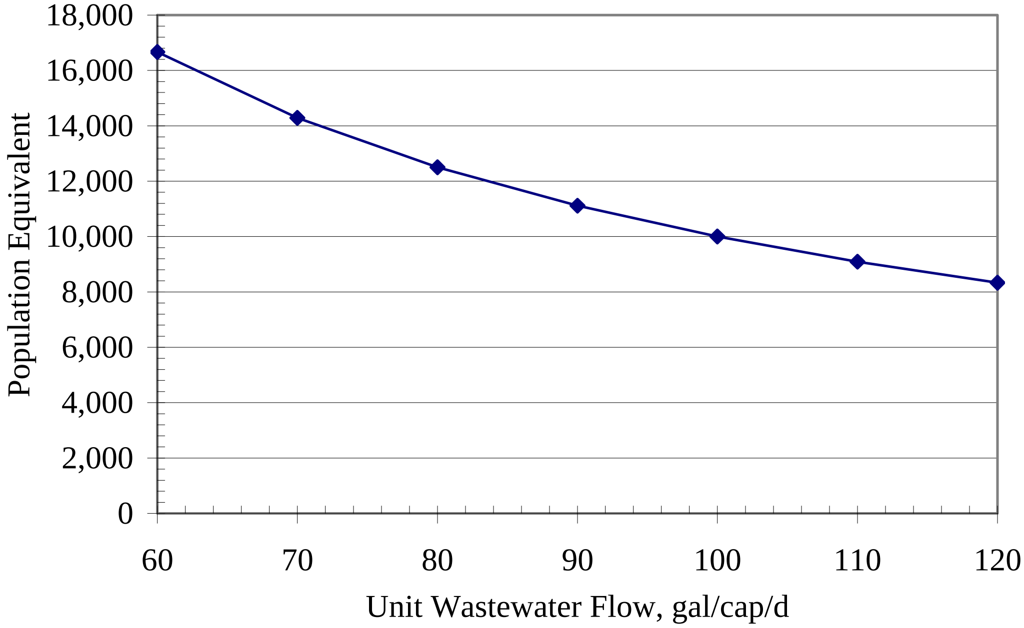


Figure 2-1
Effect of Unit Wastewater Flows on Population Equivalent Rating for 1 mgd Treatment Plant

Because the town is not currently sewered, there is no direct information on what the actual per-capita wastewater flow production will be. Potable water consumption data, however, can be used to predict wastewater flow rates when adjusted for potable water uses that do not return to the sewer. In most communities, irrigation is the main use of potable water that does not return to the sewer. The town of Yucca Valley, however, uses less water for irrigation than most desert communities. For that reason, annual potable demand is a reasonable indicator of annual wastewater production.

A separate analysis of District potable water demands indicates an annual average potable demand of 100 gal/cap/day[1], which would be a relatively high unit wastewater flow rate for a desert community. For example, a recent evaluation of the Coachella Valley Water District's service area indicated a wastewater production rate of 70 gal/cap/day[2]. Unit wastewater flow rates are often as high or higher than 100 gal/cap/day in systems with high groundwater and older, leaking sewers that allow groundwater to infiltrate into the sewer. For this project, groundwater is far below the sewer elevations, and new construction will not allow much infiltration or inflow. For these reasons, a per-capita wastewater flow rate of 83 gal/cap/day is assumed, with a corresponding Phase 1 population equivalent of 12,000 people.

Table 2-1 summarizes these assumptions and criteria.

Table 2-1
Phase 1 Service Area Assumptions

Parameter	Value
Average Annual Wastewater Flow	1.0 mgd
Per-Capita Average Wastewater Flow	83 gal/cap/day
Equivalent Service Area Population	12,000

2.1.2 Average Mass Loading Assumptions

The key influent mass loadings assumptions needed to size the treatment facilities are BOD, total suspended solids (TSS), and ammonia. Of these, BOD is the most important. TSS and ammonia concentrations can be assumed relative to the BOD load.

Typical per-capita BOD loadings range from 0.18 to 0.22 lb BOD_5/cap/day[3]. The lower range is typically seen in areas where garbage disposals are not used, and the higher of the range in areas where garbage disposals are heavily used. Although garbage disposals might not be common now in Yucca Valley, the practice could become much more common when the area is sewered. For this reason, the value of 0.22 lb BOD_5/cap/day is assumed.

Influent TSS concentrations are typically close to BOD_5 concentrations, and are assumed to be the same for this project.

Influent BOD_5 to ammonia-nitrogen[c] ratios are typically close to 8:1 for most facilities without significant industrial or food-processing waste streams. Because Yucca Valley has little or no industrial or food processing facilities, the typical 8:1 ratio is assumed. Another important assumption for nitrogen control is the amount of nitrogen that can be converted to nitrate, which will be limited in the discharge. Total Kjeldahl Nitrogen (TKN) is a measure of the total ammonia nitrogen and organic nitrogen. The typical ratio of TKN to ammonia-nitrogen is 1.7:1.

Table 2-2 summarizes the assumed average mass loading assumptions for the plant.

Table 2-2
Average Influent Mass Loading Assumptions for 1 Mgd Average Annual Flow

Parameter	Value
Population Equivalent	12,000 people
Per Capita BOD_5 Average Production	0.22 lb/cap/day
Average Influent BOD_5	2400 lb/day
Ratio Influent BOD_5:TSS	1:1
Average Influent TSS	2400 lb/day

[c] Ammonia concentrations are expressed in terms of the amount of nitrogen present in the ammonia, rather than in the total amount of ammonia.

Parameter	Value
Ratio Influent BOD5:Ammonia-Nitrogen	8:1
Average Influent Ammonia-Nitrogen	300 lb/day
Ratio TKN:Ammonia-Nitrogen	1.7:1
Average Influent TKN	510 lb/day

2.1.3 Influent Peak Flows

Hydraulic peaking factors describe how much higher the highest monthly, weekly, daily, and hourly flows are compared to the average annual flows. Peak hour factors are particularly important to size pump capacities, pipes and other liquid conveyance elements, and certain process units. As with average per-capita flow rate and influent concentrations, peaking hour factors vary substantially among different collection systems.

To predict the peak hour factor for this plant, peak flow data were collected from similar wastewater treatment plants in southern California, as summarized in **Table 2-3**. Peak flow factors are the result of multiple collection system characteristics such as the topography of the service area (steep areas typically have less inflow than flat areas), the age of the sewers (more recently-constructed sewers typically have less infiltration than older systems), the depth to groundwater (high groundwater causes high infiltration), and how well the system is maintained. Based on the data shown in **Table 2-3**, a reasonable peaking factor assumption is 3.0. The actual peaking factor might be significantly less, but it would be insufficiently conservative to assume so before the system is built. As the system expands, additional data will be available to determine the actual peaking factor.

Table 2-3
Peak Hour Flow Factors at Other
Southern California Wastewater Facilities

Plant	Average Flow, mgd	Peak Hour Flow, mgd	Peak Hour Factor
4S Ranch WWTP	0.65	2.0	3.1
Western Riverside	3.5	7.0	2.0
Valley Sanitary District WWTP	6.2	10.5	1.7
Corona Plant 3	0.4	1.1	2.8

Table 2-4 shows the assumed influent peak hour flow.

Table 2-4
Peak Hour Flow Assumptions

Parameter	Value
Average Annual Influent Flow (Phase 1)	1.0 mgd
Peak Hour Flow Factor	3.0
Design Peak Hour Influent Flow	3.0 mgd

2.1.4 Influent Peak Mass Loadings

As with hydraulic flows, influent mass loadings vary from month to month, week to week, day to day, and within the day. **Table 2-5** summarizes the assumptions for peak mass loading rates.

Table 2-5
Peak Influent Mass Loading Assumptions

Parameter	BOD_5	TSS	Ammonia-N	TKN
Peaking Factors (Pk/Ann. Avg)				
Peak Month	135%	135%	135%	135%
Peak Week	150%	150%	150%	150%
Peak Day	160%	160%	160%	160%
Average Annual Loading, lb/day	2400	2400	400	690
Peak Loadings, lb/d				
Peak Month	3200	3200	540	930
Peak Week	3600	3600	600	1040
Peak Day	3800	3800	640	1100

2.2 TREATED EFFLUENT LIMITATIONS

Treatment requirements for the Hi-Desert Water Reclamation Facility (WRF) will be established by the Colorado River Basin Regional Water Quality Control Board (RWQCB) through a Waste Discharge Requirements permit. In general the treatment requirements will be based on the October 2005 Water Quality Control Plan – Colorado River Basin Region 7 (Plan), and set to not degrade the existing groundwater quality.

2.2.1 Final Effluent Limits

There are currently no limits identified for BOD and TSS. Typical standards for tertiary treatment limit average BOD_5 and TSS concentrations to less than 10 to 20 mg/L. For this report, effluent BOD and TSS limits of 10 mg/L are assumed. These limits can be reliably achieved by the treatment systems appropriate for this project.

Nitrogen in the Plan is identified as having a limit of 10 mg/L for initial planning purposes. For this report, an effluent TIN concentration limit of 8 mg/L on a monthly average basis is assumed. Consideration should be given, however, to the ability to reach lower effluent nitrogen concentrations in the future.

The waters in this region are slightly alkaline, with a pH range of 6.0-9.0. Therefore, all discharges shall not cause changes in pH that would be considered detrimental to the beneficial uses of the water.

Emerging contaminants including NDMA, personal care products and pharmaceuticals (PCPP) and disinfection by-products, while not currently regulated by RWQCB, may become an issue of concern in the future. These emerging contaminants are considered during the process technology selection.

2.2.2 Summary of Assumed Treated Effluent Limitations

Based on the Plan and similar plants' discharge requirements and the likely modifications discussed above, **Table 2-6** summarizes the anticipated discharge requirements for the Hi-Desert WRF.

Table 2-6
Anticipated Effluent Discharge Limitations for the Hi-Desert WRF

Parameter	Value	Units
BOD_5		
Maximum monthly average	10	mg/L
TSS		
Maximum monthly average	10	mg/L
Total Inorganic Nitrogen		
12-month average	8	mg/L
Total Coliform		
7-day median	2.2	MPN/100 ml
Single sample maximum	23	MPN/100 ml
pH		
Maximum	6.5-8.5	

2.3 SOLIDS HANDLING AND DISPOSAL

The Hi-Desert WRF will generate solids which will require disposal or reuse, which is subject to state and federal regulations. Solids can be classified into three categories, depending on the level of treatment provided. The disposal options are dependent on the treatment level provided. The following is a description of the classifications, how the required treatment can be achieved with the proposed wastewater treatment facilities, and how the solids can be applied.

2.3.1 Class A Requirements

Class A solids have the highest degree of treatment, and thus can be applied with the fewest restrictions. Class A solids contain no detectable levels of pathogens, meet strict vector attraction requirements and low levels of metal contents. Class A solids can generally be distributed and applied in public areas with little monitoring of off-site use. The degree of regulatory monitoring depends on whether the treated solids first met Class B requirements or were made from unclassified solids. With unclassified solids as the raw material, a special composting permit is required, along with the associated monitoring and reporting.

2.3.2 Class B Requirements

Class B solids require a lower degree of treatment than Class A, and thus are restricted in application. Class B solids can be applied to agricultural fields and other areas which are not accessible to the general public. The solids producer is responsible for monitoring how the solids are applied at the point of use and for compliance with all regulations at the point of use.

2.3.3 Unclassified Solids

Solids which do not comply with either the Class A or Class B requirements are considered unclassified. Disposal options include landfilling or shipment to an off-site solids handler. Many similar wastewater treatment plants in the area hire contract operators to remove solids for disposal or reuse. These firms typically either sell the material for agricultural use, for which the hauler is responsible, or compost the material for less restrictive reuse. The advantage of this solution is that no additional on-site facilities are required and a third party assumes responsibility for regulatory requirements of disposal.

The requirements for Class A and Class B are summarized in **Table 2-7**. In addition to the pathogen reduction requirement, solids must also meet the vector attraction reduction (VAR) before the solids can be beneficially reused. VAR requirements can be found in **Table 2-8**. Processes to further reduce pathogens (PRFPs) can be found in **Table 2-9**.

Table 2-7
Summary of Class A and Class B Pathogen Reduction Requirements

CLASS A	CLASS B
In addition to meeting the requirements in one of the six alternatives listed below, fecal coliform or bacterial levels must meet specific densities at the time of sewage sludge use or disposal	The requirements in one of the three alternatives below must be met.
Alternative 1: Thermally Treated Sewage Sludge Use one of four time-temperature regimes.	**Alternative 1: Monitoring of Indicator Organisms** Test for fecal coliform density as an indicator for all pathogens at the time of sewage sludge use or disposal.
Alternative 2: Sewage Sludge Treated in a High pH-High Temperature Process Specifies pH, temperature, and air-drying requirements.	**Alternative 2: Use of Process to Significantly Reduce Pathogens (PSRP)** Sewage sludge is treated in one of the processes to Processes to Significantly Reduce Pathogens PSRP (see **Table 2.9**).
Alternative 3: For Sewage Sludge Treated in Other Processes Demonstrate that the process can reduce enteric viruses and viable helminth ova. Maintain operating conditions used in the demonstration.	**Alternative 3: Use of Processes Equivalent to PSRP** ***Sewage sludge is treated in a process equivalent to one of the PSRPs, as determined by the permitting authority.***
Alternative 4: Sewage Sludge Treated in Unknown Processes Demonstration of the process is unnecessary. Instead, test for pathogens–salmonella bacteria, enteric viruses, and viable helminth ova–at the time of sewage sludge is used or disposed of or prepared for use or disposal.	
Alternative 5: Use of Process to Further Reduce Pathogens (PFRP) Sewage sludge is treated in one of the Processes to Further Reduce Pathogens (PFRP) (see **Table 2.9**).	
Alternative 6: Use of a Process Equivalent to PFRP ***Sewage sludge is treated in a process equivalent to one of the PFRPs, as determined by the permitting authority.***	

Table 2-8
Summary of Vector Attraction Reduction Options

Requirements in one of the following options must be met:

Option 1:	Reduce the mass of volatile solids by a minimum of 38 percent.
Option 2:	Demonstrate vector attraction reduction with additional anaerobic digestion in a bench-scale unit.
Option 3:	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit.
Option 4:	Meet a specific oxygen uptake rate for aerobically treated sludge.
Option 5:	Use aerobic processes at greater than 40ºC (average temperatures 45ºC) for 14 days or longer (e.g., during sewage sludge composting).
Option 6:	Add alkaline materials to raise the pH under specified conditions.
Option 7:	Reduce moisture content of sewage sludge with unstabilized solids from other than primary treatment to at least 75 percent solids.
Option 8:	Reduce moisture content of sewage sludge with unstabilizied solids to at least 90 percent.
Option 9:	Inject sewage sludge beneath the soil surface within a specified time depending on the level of pathogen treatment.
Option 10:	Incorporate sewage sludge placed on the land surface within specified time periods after placement on the land surface, depending on the level of pathogen treatment.

Table 2-9
Processes to Further Reduce Pathogens (PFRPs)
Listed in Appendix B of 40 CRF Part 503

1. *Composting*

Using either the within-vessel composting method or the static aerated pile composting method, the temperature of the sewage sludge is maintained at 55ºC or higher for three days.

Using the windrow composting method, the temperature of the sewage sludge is maintained at 55ºC or higher for 15 days or longer. During the period when the compost is maintained at 55ºC or higher, the windrow is turned a minimum of five times.

2. *Heat Drying*

Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10 percent or lower. Either the temperature of the sewage sludge particles exceeds 80ºC or the wet bulk temperature of the gas in contact with the sewage sludge as the sewage sludge leaves the dryer exceeds 80ºC.

3. *Heat Treatment*

Liquid sewage sludge is heated to a temperature of 180ºC or higher for 30 minutes.

4. *Thermophilic Aerobic Digestion*

Liquid sewage sludge is agitated with air or oxygen to maintain aerobic conditions, and the mean cell residence time of the sewage sludge is 10 days at 55º to 60ºC

5. *Beta Ray Irradiation*

Sewage sludge is irradiated with beta rays from an accelerator at dosages of at least 1.0 megarad at room temperature (ca. 20ºC).

6. *Gamma Ray Irradiation*

Sewage sludge is irradiated with gamma rays from certain isotopes, such as Cobalt 60 and Cesium 137, at room temperature (ca. 20ºC).

7. *Pasteurization*

The temperature of the sewage sludge is maintained at 70ºC or higher for 30 minutes or longer.

8. *Aerobic Digestion*

Sewage sludge is agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 40 days at 20ºC and 60 days at 15ºC.

Table 2-9
Processes to Further Reduce Pathogens (PFRPs)
Listed in Appendix B of 40 CRF Part 503

9. Air Drying

Sewage sludge is dried on sand beds or on paved or unpaved basins. The sewage sludge dries for a minimum of three months. During two of the three months, the ambient average daily temperature is above 0ºC.

10. Anaerobic Digestion

Sewage sludge is treated in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35ºC to 55ºC and 60 days at 20ºC.

11. Composting

Using either the within-vessel, static aerated pile, or windrow composting methods, the temperature of the sewage sludge is raised to 40ºC or higher and remains at 40ºC or higher and remains at 40ºC or higher for five days. For four hours during the five-day period, the temperature in the compost pile exceeds 55ºC.

12. Lime Stabilization

Sufficient lime is added to the sewage sludge to raise the pH of the sewage sludge to 12 after two hours of contact.

[1] Sewer System Master Plan, in progress
[2] Coachella Water Master Plan.
[3] Metcalf & Eddy, "Wastewater Treatment and Reuse," 4th Edition, Table 3-12, page 182.

Section 3
Initial Technology Screening

In 1999, the Hi-Desert Water District (District) used federal funds to prepare detailed design drawings for a new 1 mgd wastewater treatment plant that was to be located on a site just east of Avalon Avenue, north of Yucca Creek. At the time, the District intended to keep the design documents "on the shelf" so that when the time came that the Colorado River Basin Regional Water Quality Control Board (RWQCB) required a wastewater collection and treatment system, the plans would be ready. Just after the 90% design drawings were completed, public input led the District to choose a different site for the plant, and delay any further work on the design.

Since the design work was placed on hold, there have been some changes in the wastewater treatment industry and in the project needs:

- Membrane bioreactors have become a more mature technology and are now much more cost competitive with conventional technologies. Membrane bioreactors use porous membranes to separate the biological solids used for treatment from the final effluent instead of sedimentation in clarifiers following by filtration.

- The District has decided to dispose of plant effluent through on-site recharge basins. These basins require more space on the site than was originally planned.

- Energy costs and concerns with sustainability have raised a greater interest in green technologies, such as solar power.

These and other factors warrant a reevaluation of the main technologies chosen in the previous plan. The following areas were selected for additional evaluation:

- System-Wide Configuration (see Table 3-2)
- Treatment Technologies (see Table 3-3)
- Disinfection Technologies (see Table 3-4)
- Solids Handling (see Table 3-5)
- Power Supply (see Table 3-6)
- Structural Configuration (see Table 3-7)

Although there are many alternatives, most have one or more characteristics that make them unsuitable for this project. This section lists a broad range of alternatives for each of the topics listed above, and for most of them, the particular "fatal flaw" that makes them unsuitable for further evaluation. The remaining alternatives without obvious fatal flaws are summarized in **Table 3-1.**

Table 3-1
Summary of Screened Technology

Screening Category	Remaining Alternatives
System-Wide Configuration	• Centralized Wastewater Treatment
Treatment Technologies	• Extended Aeration • Membrane Bioreactors (MBR) • Conventional High Rate Aeration
Disinfection Technologies	• Ultraviolet Disinfection (UV)
Solids Handling (Disposal)	• Thickened Sludge Handling • Dewatered Sludge Handling
Solids Handling (Treatment)	• Aerobic Digestion • Lime Stabilization • Not Stabilized (Stabilization not required for Ex. Aeration)
Solids Handling (Thickening/Dewatering)	• Conventional Sludge Drying Beds
Power Supply	• Southern California Edison
Structural Configuration. (Hydraulic Structures)	• Cast-In-Place Concrete
Structural Configuration. (Buildings)	• Trailers • Pre-Fabricated • Wood Frame Stucco • Concrete Masonry

3.1 SYSTEM-WIDE CONFIGURATION

System-wide configuration alternatives address how and if wastewater should be collected, and where it should be treated. The screening of system-wide configuration alternative is presented in **Table 3-2**. Options such as no-flush toilets and gray water separation would require extensive and disruptive modification of toilets and plumbing in all existing buildings in the service area. Decentralized treatment is not cost effective for an area such as Yucca Valley where development has occurred in single, coherent area. Piping sewage to a neighboring agency would be very expensive to construct the sewers, and would result in the permanent loss of the water that could otherwise be used for groundwater recharge. For these reasons, only centralized treatment of wastewater within the District's service area is considered a viable alternative.

3.2 TREATMENT TECHNOLOGIES

There are many different types of wastewater treatment technologies that can be used, as listed in **Table 3-3**. But of these, only three are cost-effective and viable technologies for plants of this size in southern California that must produce disinfected tertiary effluent with nitrogen removal. Those technologies are extended aeration, membrane bioreactors, and conventional high-rate activated sludge.

3.3 DISINFECTION TECHNOLOGIES

The California Department of Public Health (DPH) currently only recognizes two methods of disinfecting effluent for unrestricted Title 22 water reclamation; chlorination and UV disinfection, as listed in **Table 3-4**.

At this size facility, chlorination requires the use of chlorine gas, sodium-hypochlorite solution, or some other form of hypochlorite. Chlorination creates disinfection byproducts such as NDMA[1] that are significant and emerging concerns for sources of drinking water. Chlorination also increases the total dissolved solids of the final effluent by 10 to 30 mg/L. Because the final effluent will percolate to groundwater used for potable water supply, chlorination is not considered an advisable disinfection option for this particular project.

3.4 SOLIDS HANDLING

Solids handling involves disposal of the solids, measures to stabilize the sludge, and measures to thicken and dewater the sludge. Solids handling alternatives are grouped by category in **Table 3-5.**

3.4.1 Disposal

Disposal options include:

- Hauling unthickened sludge (approximately 1% solids);
- Thickened sludge (approximately 2 to 10% solids);
- Dewatered sludge (12 to 30% solids); or
- Dried sludge, or by incinerating the sludge.

Hauling unthickened and thickened sludge is seldom practical except where a pipeline can be constructed to another plant within 20 miles or less. There are no plants capable of handling the solids from this plant within that radius. Incineration is not generally recognized as a viable option in southern California due to air quality standards, and equipment that can meet the standards is too complex for a plant of this size. Hauling of dewatered sludge is considered the only viable option, although dewatered sludge can be air-dried prior to off-site disposal if time, space, and weather allow.

[1] *N*-Nitrosodimethylamine (NDMA), also known as dimethylnitrosamine (DMN), is a semi-volatile organic chemical that is highly toxic and is a suspected human carcinogen.

3.4.2 Stabilization

Sludge stabilization is used to reduce pathogen concentrations, reduce vector[2] attraction, reduce odor potential, and meet certain regulatory requirements for particular disposal alternatives. Stabilization is not required, however, for landfill disposal, or hauling to an off-site, third-party composting operation. For activated-sludge treatment processes with solids residence times of less than 25 days, some aerobic stabilization of sludge should be provided before dewatering and off-site disposal to minimize odors when storing on-site or when hauling. Further stabilization of extended aeration waste sludge is not required.

Anaerobic digestion, which is common for larger plants, is not considered viable for a small plant like this due to its complexity and high-capital cost.

3.4.3 Thickening and Dewatering

Sludge drying beds typically have the least capital and operating cost of any of the dewatering options for plants up to 1 or 2 mgd in hot dry climates. At larger sizes, the space requirements are often not practical. The key disadvantages of sludge drying beds are the potential for odors and vector attraction, particularly with flies. Due to the adverse impact of sludge drying beds, mechanical dewatering is recommended.

3.5 POWER SUPPLY

Table 3-6 lists the available technologies for power supply. Of these technologies, however, the only viable, reliable and continuously available power supply is the public power utility, in this case Southern California Edison (SCE). Diesel engine generators will be needed for backup power when the SCE supply is interrupted. The treatment processes proposed for this plant do not produce a biogas that could be used for biogas co-generation.

Solar and wind generation can be attractive options, but require a significant capital expenditure. The viability of solar and wind generation is generally unrelated to wastewater treatment, and is not considered in this report. Spare space on the site could be used for solar or wind generation without impacting the plant operation.

If the District is interested in pursuing solar or wind generation, a separate evaluation should be performed to determine the economic feasibility.

3.6 STRUCTURAL CONFIGURATIONS

Structures at the wastewater treatment plant can be divided between hydraulic structures, and buildings.

3.6.1 Hydraulic Structure

The hydraulic structures of most plants this size are constructed of cast-in-place concrete. Some structures can be made of welded steel, but these have significantly shorter lives, higher

[2] In this case vectors are birds, vermin and insects that may spread the solids to neighboring areas.

maintenance, and less reliability. Cast-in-place concrete is recommended for all hydraulic structures.

3.6.2 Buildings

Buildings, whether used to house equipment or people can consist of trailers all the way through cast-in-place structures. The trade-offs involve the visual appeal, long-term durability, and reliability during natural disasters such as earthquakes and wind storms.

In the case of buildings, the choice of construction is the preference of the District and the community.

Table 3-2
Fatal Flaw Evaluation for System-Wide Configuration Alternatives

	Politically Acceptable	Cost Effective	Straight-forward Implementation	Suitable for Waste Stream	Minimal Environmental Impact	Ease of Permitting	Other	Continue for Further Evaluation
System-Wide Configuration Alternatives								
Decentralized Wastewater Treatment		Higher Capital and O&M Costs than Centralized			Multiple discharge points to maintain	Requires discharge permits for multiple locations	Best suited to systems with high reclaimed water demand	NO
Convey Wastewater to Neighboring District for Treatment	Requires high level of coordination with outside district/loss of control over treatment				Loss of water available for groundwater recharge			NO
Centralized Wastewater Treatment								YES
Grey-water Separation/Centralized Wastewater Treatment	Requires acceptance from all customer locations	Although reducing wastewater generation, treatment plant still required	Process to change out systems at all customer locations required					NO
No-Flush Toilets/Centralized Wastewater Treatment	Requires acceptance from all customer locations	Although reducing wastewater generation, treatment plant still required	Process to change out systems at all customer locations required	Initial Phase of implementation is mostly commercial which is unsuitable for no-flush toilets				NO

Table 3-3
Fatal Flaw Evaluation for Treatment Technologies

	Proven Technology For Municipal Applications	Cost Effective	Suitable for Size of Plant	Suitable for Plant Site	Can Meet Nitrogen Limits	Other	Continue for Further Evaluation
TREATMENT TECHNOLOGIES							
Physical Processes							
Chemical Process • Flocculation - Sedimentation • Microfiltration (Direct)	Systems proven to be un-suitable	Systems is prohibitively expensive at small scale			Unable to meet nitrogen limits		NO
Biological Processes							
Aerobic Processes (Suspended Growth\Activated Sludge)							
• High Rate (High Purity Oxygen)		System is prohibitively expensive at small scale	System is prohibitively complex at small scale		Limited nitrogen removal capability	High level of operator safety training required.	NO
• Sequencing Batch Reactor (SBR)		Full reduncy required resulting in higher capital costs				Difficulty handling peak flows, peaks not well established in new system	NO
• Extended Aeration							YES
• Membrane Bioreactors (MBR)							YES
• Conventional Rate							YES
Aerobic Processes (Attached Growth) • Trickling Filters (High & Low Rate) • Roughing Filters • Rotating Biological Contactors					Unable to meet nitrogen limits		NO
Aerobic Processes (Combined Attached and Suspended Growth) • Activated Biofilter • Trickling Filter - Solids Contact • Biofilter Activated-Sludge Process • Trickling Filter-Activated Sludge					Unable to meet nitrogen limits		NO
Anaerobic Processes • Suspended Growth (Anaerobic Solids Contact\Upflow Anaerobic Sludge Blanket • Attached Growth (Anaerobic Filter/Expanded Bed)					Unable to meet nitrogen limits		NO
Pond Processes • Aerobic Ponds • Maturation Ponds • Facultative Ponds • Anaerobic Ponds				Ponds use extensive land and can have problems with odors and vectors		Not suited to future expansions	NO

Table 3-4
Fatal Flaw Evaluation for Disinfection Technologies

	Proven Technology For Municipal Applications	Cost Effective	Suitable for Size of Plant	Suitable for Plant Site	Minimal Environmental Impact	Required Permits can be Obtained	Within Control of Hi-Desert WD	Other	Continue for Further Evaluation
DISINFECTION TECHNOLOGIES									
Note: The only two methods the California Department of Public Health (DPH) has approved for disinfection of tertiary effluent are ultraviolet (UV) disinfection and chlorination.									
Ultraviolet Disinfection									YES
Chlorination/Dechlorination					Produces NDMAs which may be restricted for future groundwater recharge. Adds salinity to effluent.				NO

Table 3-5
Fatal Flaw Evaluation for Solids Handling Technologies

	Proven Technology For Municipal Applications	Cost Effective	Suitable for Size of Plant	Minimal Environmental Impact	Required Permits can be Obtained	Disposal Flexibility	Other	Continue for Further Evaluation
SOLIDS HANDLING TECHNOLOGIES								
Solids Disposal								
Thin Sludge Handling		High sludge hauling costs		Impact on air quality from high sludge volume hauling		Requires additional treatment by third party		NO
Thickened Sludge Handling		High sludge hauling costs		Large volume of truck traffic		Requires additional treatment by third party		NO
Dewatering Sludge Handling								YES
Dried Sludge Handling		Higher equipment/power /O&M costs not offset by reduced hauling costs at small volumes						NO
Incineration		Higher equipment/power /O&M costs not offset by reduced hauling costs at small volumes			Difficult to Permit			NO
Treatment of Solids								
Onsite Composting		Higher equipment/power /O&M costs not offset by reduced hauling/disposal costs at small volumes				Requires development of consumer base for product		NO
Anaerobic Digestion		Not cost effective at smaller scales	Disproportional operations demand for small plant					NO

Table 3-5 (Continued)
Fatal Flaw Evaluation for Solids Handling Technologies

Aerobic Digestion								YES
Thermal Drying		Higher equipment/power /O&M costs not offset by reduced hauling costs at small volumes						NO
Incineration		Higher equipment/power /O&M costs not offset by reduced hauling costs at small volumes			Difficult to Permit			NO
Lime Stabilization						Restricts options for solids disposal		NO
Un-Stabilized (*Suitable for extended aeration only)								YES*
Thickening/Dewatering of Solids								
Conventional Sludge Drying Beds								YES
Vacuum Assisted Sludge Drying		Not cost effective at initial plant size.						NO
Solar Sludge Drying Beds		Not cost effective at initial plant size.						NO
Centrifuge		Not cost effective at initial plant size.					Requires additional enclosure	NO
Belt Press		Not cost effective at initial plant size.					Requires additional enclosure	NO
Screw Press		Not cost effective at initial plant size.						NO
Plate-n-Frame	Technology has fallen out of favor for last 20 years	Not cost effective at smaller scales					Requires additional enclosure	NO

Table 3-6
Fatal Flaw Evaluation for Power Supply Technologies

	Suitable for Plant Treatment Process	Cost Effective	Minimal Environmental Impact	Required Permits can be Obtained	Continue for Further Evaluation
POWER SUPPLY TECHNOLOGIES					
On-Site Generation - Diesel		High fuel and maintenance cost	Combustion engine impacts air quality	Difficult to Permit	NO
On-Site Generation - Natural Gas		High fuel and maintenance cost		Difficult to Permit	NO
On-Site Generation - Biogas	No generation of biogas on site				NO
Solar Generation		Not reliable power source/combination with SCE power can be explored by District separately			Optional
Wind Generation		Not reliable power source/combination with SCE power can be explored by District separately.			Optional
Southern California Edison					YES

Table 3-7
Fatal Flaw Evaluation for Structural Configuration

	Cost Effective	Long Term Reliability	Reasonable Maintenance Costs	Other	Continue for Further Evaluation
STRUCTURAL CONFIGURATION					
Hydraulic Structures					
Pre-Fab Steel Tanks		Structure highly susceptible to corrosion and wear effects	High maintenance costs		NO
Above Ground Steel		Structure highly susceptible to corrosion and wear effects	High maintenance costs		NO
Cast-in-Place Concrete					YES
Buried and Concealed	Not cost effective			Not suitable for future expansion	NO
Buildings					
Trailers					Optional
Pre-Fabricated					Optional
Wood Frame Stucco					Optional
Concrete Masonry					Optional
Cast- in-Place Concrete	Not cost effective at smaller scales				NO

Section 4
Technology Selection

The screening process presented in Section 3, Initial Technology Screening identified three treatment options for further evaluation, as summarized in **Table 4-1**. The development and comparison of alternatives described below was completed in February 2008. Since that time, some significant changes have occurred:

- Sludge dewatering was planned to initially be accomplished by solar sludge drying beds. Following a further review the District decided that dewatering should be accomplished mechanically instead.

- An assumption had been previously made that the Regional Water Quality Control Board (Regional Board) would subject the disposal of effluent from this plant to the Department of Public Health's (DPH) groundwater recharge regulations. Since then the Regional Board staff has indicated that the discharge permit will be subject to effluent disposal limitations, and not to groundwater recharge regulations.

- The District has tentatively decided to build the treatment plant through an alternative delivery process. Because that alternative delivery process is likely to evaluate the treatment technologies in much more detail, the District has decided to proceed with this report on the assumption that the treatment technologies used for the previous, un-built treatment plant designed for the site east of Avalon Avenue just north of Yucca Creek would be used for the new project.

This section has not been revised to reflect these changes, but the unit process and site development sections have been revised accordingly.

Table 4-1
Summary of Technology Screening

Screening Category	Options Selected for Further Evaluation
Treatment Technologies	1. Extended Aeration 2. Membrane Bioreactors (MBR) 2A. High Rate MBR 2B. Extended Aeration MBR 3. Conventional High Rate Activated Sludge

4.1 ALTERNATIVE DEVELOPMENT

The three options listed above can be assembled into four alternatives, with the MBR option divided into two alternatives, one with the same 8-day sludge age of the high rate activated sludge alternative, and the other with the 25-day sludge age of the extended aeration alternative.

4.1.1 Alternative 1 - Conventional Extended Aeration

A conventional extended aeration process uses the activated sludge process, secondary clarification, and tertiary filters to produce a filtered effluent ready for disinfection. The sludge age is typically 25 days or higher to produce a waste activated sludge (WAS) sufficiently stabilized to be dewatered without significant emissions. A process flow schematic for the extended aeration process is shown in **Figure 4-1**. The process units in bold are the units that vary based on the alternative. The other process units are common to all alternatives.

For the purposes of this evaluation, the biological nutrient removal (BNR) process is assumed to be an oxidation ditch with an anoxic zone and mixed liquor recycle. The choice of specific BNR configuration is not likely to affect the comparison of this alternative to the other three treatment alternatives. Filtration was assumed to be cloth disk filters, which are particularly cost competitive.

The design criteria for the extended aeration alternative is described in **Table 4-2**.

Table 4-2
Alternative 1 Extended Aeration Sizing Criteria

Parameter	Value
<u>Reactor Sizing</u> Sludge Retention Time (SRT) Mixed Liquor Concentration	 25 days 4,000 mg/L
<u>Clarifier Loading Rates</u> Average Surface Overflow Rate Peak Surface Overflow Rate Average Solids Loading Rate Peak Solids Loading Rate	 300 gpd/ft^2 600 gpd/ft^2 18 lb/d/ft^2 35 lb/d/ft^2
<u>Filtration</u> Filtration Type	 Cloth Disc

Figure 4-1 Process Flow Schematic for Extended Aeration

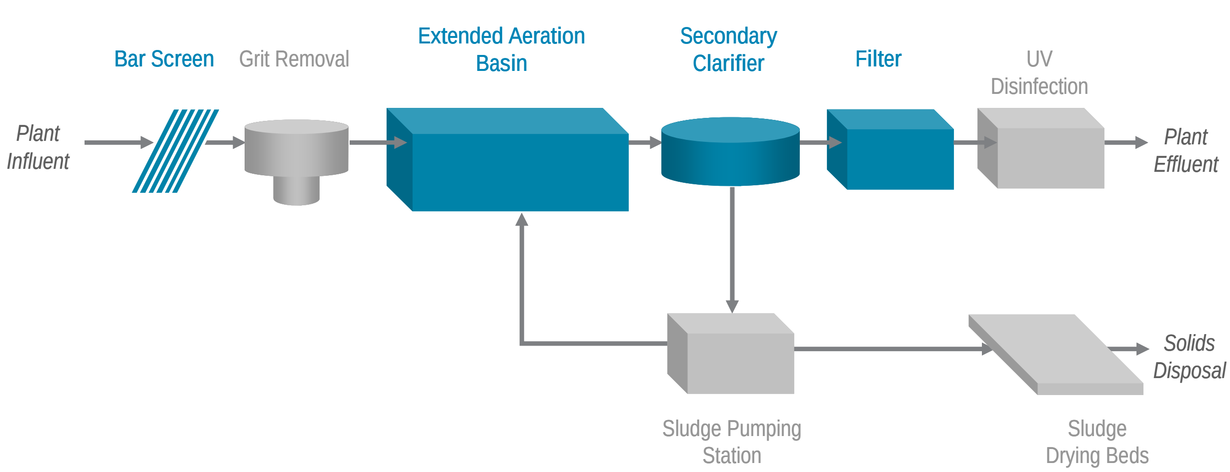
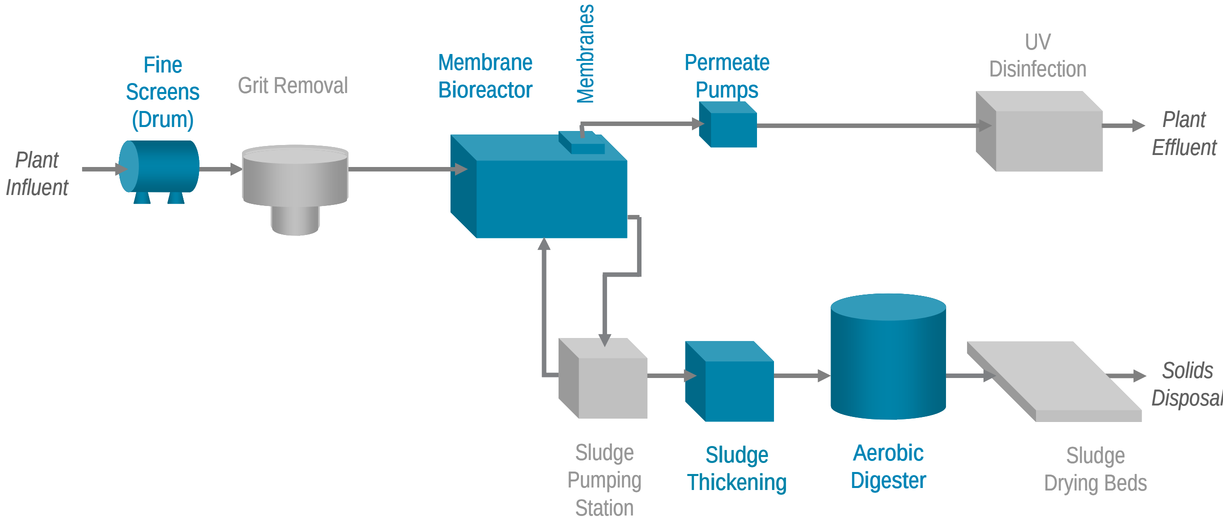


Figure 4-2 Process Flow Schematic for High Rate MBR



UV Disinfection Type Design Dose Design Effluent Transmittance	 Low pressure, high intensity 100 mW-sec/cm^2 55%
Solids Handling Net Yield Ratio Dewatering Equipment	 0.80 lb TSS/lb BOD_{rem} Sludge drying beds

4.1.2 Alternative 2A – High-Rate Membrane Bioreactor (MBR)

The high-rate membrane bioreactor (MBR) alternative uses the activated sludge process in combination with submerged membrane filtration to provide the functions normally provided by aeration basins, secondary clarification and tertiary filtration. As a result there is no need for clarifiers or filters. Denitrification is accomplished by providing anoxic zones in the activated sludge process. Disinfection is accomplished with UV. Due to the low sludge age in the high-rate process, further stabilization of the sludge is required. Stabilization will be accomplished with aerobic digesters preceded by sludge thickening. A process flow schematic for the high rate MBR process is shown in **Figure 4-2**. The process units in bold are the units that vary based on the alternative. The other process units are common to all alternatives.

For this evaluation, the values for mixed liquor suspended solids concentration, sludge retention time, and membrane flux rates are typical conservative numbers used for sizing MBR systems. The design criteria for the high-rate MBR alternative are described in **Table 4-3**.

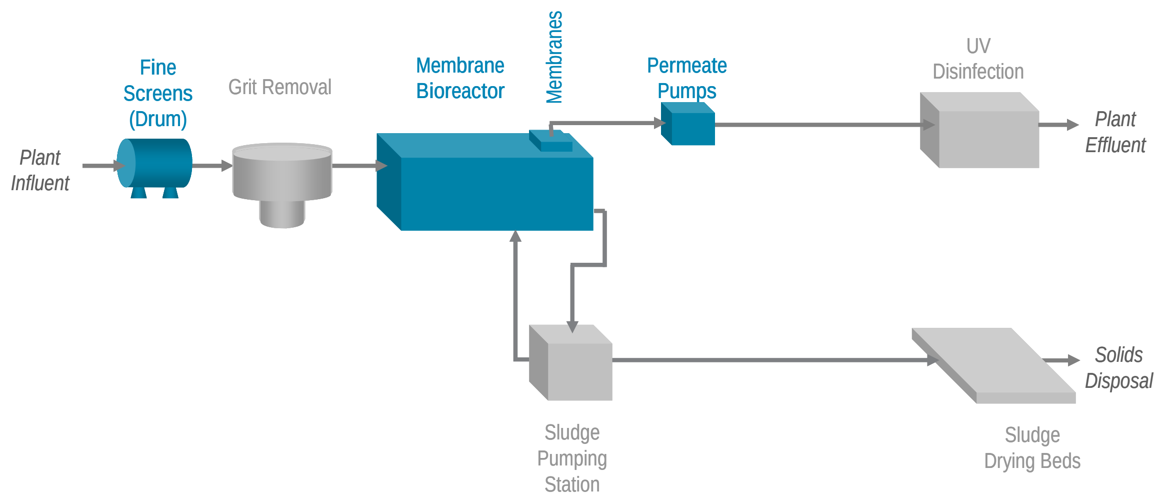
Table 4-3
Alternative 2A High-Rate MBR Sizing Criteria

Parameter	Value
Reactor Sizing Sludge Retention Time (SRT) Mixed Liquor Concentration	 8 days 8,000 mg/L
Membranes Type Flux Rate (Average) Flux rate (Peak Flow)	 submerged 10 gfd 20 gfd
UV Disinfection Type Design Dose Design Effluent Transmittance	 low pressure, high intensity 80 mW-sec/cm^2 65%
Solids Handling Net Yield Ratio Dewatering Equipment	 1.00 lb TSS/lb BOD_{rem} sludge drying beds

Alternative 2B – Extended Aeration Membrane Bioreactor (MBR)

The extended aeration MBR alternative uses the same process presented for the high-rate MBRs with the exception that the SRT is increased to 25 days to generate a stabilized sludge and eliminate the need for aerobic digesters and sludge thickening. A process flow schematic for the extended aeration MBR process is shown in **Figure 4-3**. The process units in bold are the units that vary based on the alternative. The other process units are common to all alternatives.

Figure 4-3 Process Flow Schematic for Extended Aeration MBR



For this evaluation, the values for mixed liquor suspended solids concentration, sludge retention time, and membrane flux rates are same typical conservative numbers used for the high-rate MBR alternative. The design criteria for the extended aeration MBR alternative are described in **Table 4-4**.

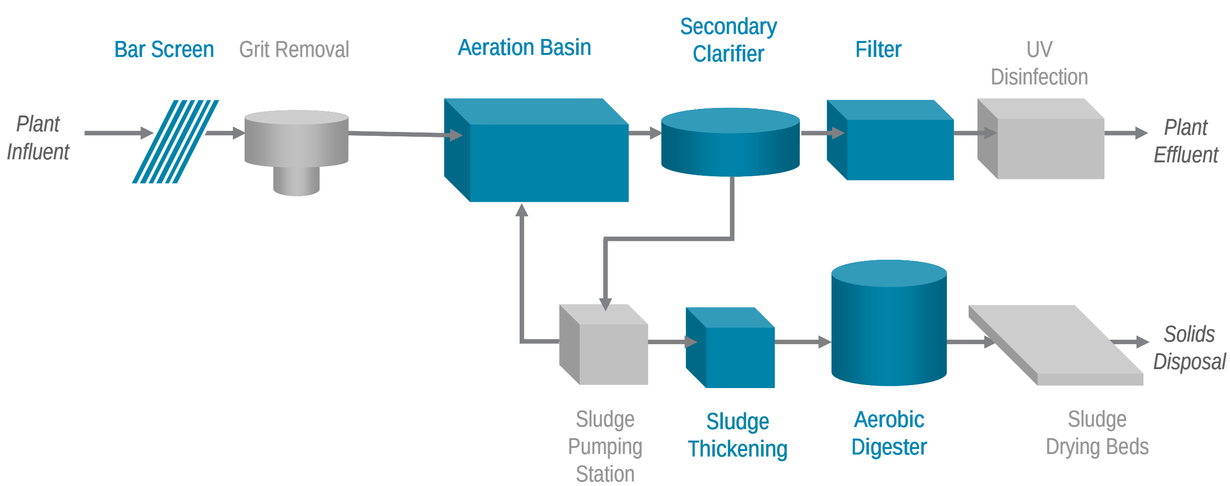
Table 4-4
Alternative 2B Extended Aeration MBR Sizing Criteria

Parameter	Value
<u>Reactor Sizing</u> Sludge Retention Time (SRT) Mixed Liquor Concentration	 25 days 8,000 mg/L
<u>Membranes</u> Type Flux Rate (Average) Flux rate (Peak Flow)	 submerged 10 gfd 20 gfd
<u>UV Disinfection</u> Type Design Dose Design Effluent Transmittance	 low pressure, high intensity 80 mW-sec/cm^2 65%
<u>Solids Handling</u> Net Yield Ratio Dewatering Equipment	 0.80 lb TSS/lb BOD_{rem} sludge drying beds

4.1.4 Alternative 3 - Conventional High Rate Activated Sludge

The high rate activated sludge alternative consists of conventional aeration basins configured in the Modified Ludzack-Ettinger (MLE) process with conventional secondary clarification and tertiary filtration upstream of UV disinfection. Due to the low sludge age, further stabilization of sludge is required. The stabilization is accomplished through the use of aerobic digesters preceded by sludge thickening. A process flow schematic for the high rate activated sludge process is shown in **Figure 4-4**. The process units in bold are the units that vary based on the alternative. The other process units are common to all alternatives.

Figure 4-4 Process Flow Schematic for High Rate Activated Sludge



The design criteria for the high rate activated sludge alternative is described in **Table 4-5**.

Table 4-5
Alternative 3 High Rate Activated Sludge Sizing Criteria

Parameter	Value
Reactor Sizing Sludge Retention Time (SRT) Mixed Liquor Concentration	 8 days 3,000 mg/L
Clarifier Loading Rates Average Surface Overflow Rate Peak Surface Overflow Rate Average Solids Loading Rate Peak Solids Loading Rate	 500 gpd/ft^2 1040 gpd/ft^2 24 lb/d/ft^2 48 lb/d/ft^2
Filtration Filtration Type	 Cloth Disc

Parameter	Value
UV Disinfection Type Design Dose Design Effluent Transmittance	 low pressure, high intensity 100 mW-sec/cm^2 55%
Solids Handling Net Yield Ratio Dewatering Equipment	 1.00 lb TSS/lb BOD_{rem} sludge drying beds

4.2 SITE DEVELOPMENT

The site selected for the new wastewater reclamation facility is on a 78-acre plot of undeveloped land with a moderate slope and a dry wash. The District has expressed interest in leaving the northern portion of the plot undeveloped for possible sale for commercial development. The sale of that portion of the site would leave approximately 43 acres for the plant facilities. The full site along with the setback is shown in **Drawing 4-1** at the end of this Section.

4.2.1 Recharge Basins

Treated effluent from the new reclamation facility would be sent to percolation ponds. There is interest in exploring whether the ponds could be located on the same plot as the reclamation facility. At the time of this report, there are no available data on the likely infiltration rate for recharge basins on the site. The initial sizing of the ponds, therefore, is based on reasonable conservative criteria. The United State Geological Survey (USGS) is planning to conduct infiltrating testing for this project. That data, when available, will be used to establish more definitive design criteria.

The blending ratio of 80 units dilution water to 20 units treated wastewater effluent would have been required as an initial value by California Department of Public Health (DPH) if the project were subject to the groundwater recharge regulations. Once the system is in operation, the groundwater quality at the potable water production wells is monitored. If justified by the monitoring data the required ratio of dilution water by be reduced to as low as 50 units dilution water to 50 units treated wastewater effluent. The sizing and criteria for the percolation ponds is presented in **Table 4-6**.

Table 4-6
Groundwater Recharge Basin Sizing and Criteria

	Conservative Values	Best Case Values
Average Treated Effluent Disposal Capacity	1.0 mgd	
Sizing Criteria Infiltration Rate Blending Ratio, dilution water: treated effluent	 1 ft/day 80:20	 3-4 ft/day 50:50
Required Recharge Basin Area	15 acres	

The initially-required percolation pond area based on the conservative criteria is 15 acre for 1 mgd. The area for the recharge basins is overlaid with the plot boundaries to demonstrate the relative scale in **Drawing 4-2**. If the infiltration rates are actually higher than the initial assumptions, or if groundwater quality monitoring justifies a lower dilution ratio, the capacity of the initial 15 acres could be much higher than 1 mgd. If neither situation occurs, additional off-site recharge basins will be required.

4.2.2 Treatment Facilities

With the assumed sale of the northern portion of the property noted above and the area required for recharge basins, the land available for the wastewater reclamation facilities on the site is greatly reduced. **Table 4-7** shows the break-up of the parcel and the land required for each of the three main treatment alternatives.

Table 4-7
Site Land Area Availability and Requirements

	Values
Total Site Area	78 acre
Available Area after Sale of North Portion*	43 acre
Area Required for 15 acre of Recharge Basins	20 acre
Area Remaining for Treatment Facilities*	23 acre
Area Required for 4 mgd of Treatment Facilities	
Alt 1- Extended Aeration	13.5 acre
Alt 2A&B- MBR	7 acre
Alt 3- High Rate Activated Sludge	12 acre

* Area assumes the wash is available for development.

The proposed layouts for the various treatment alternative are presented in **Drawings 4-3 to 4-6**. As shown in the drawings and **Table 4-7**, both MBR alternatives have a significant advantage over the other alternatives when it comes to required footprint.

4.3 COST COMPARISONS

Comparative capital and operations and maintenance (O&M) costs were developed for construction and operation of the proposed Phase 1 facilities. The value of land is not included, nor the costs for future Phases.

4.3.1 Capital Costs

Providing a meaningful estimate of probable construction cost requires a detailed definition of each portion of each alternative that is not warranted at this stage of evaluation. Rather, a reasonable budget allocation can be assumed for the various project elements, and adjustments made for the relative differences in those allocations for each alternative. Therefore, <u>the capital cost estimates used for the following evaluation should be used only for comparison of alternatives</u>. An actual opinion of probable construction cost (OPCC) for the selected alternative is described in Section 2 of this Report based on further development of the selected alternative.

The relative capital costs by process unit for the four treatment alternatives are shown in **Table 4-8**.

Table 4-8
Capital Cost by Alternative in Thousands

Process	Alt 1 Ex. Aeration	Alt 2A HR MBR	Alt 2B Ex.A MBR	Alt 3 HR AS
Unit Processes				
Influent Pump Station (Interim)	$750	$750	$750	$750
Influent Screening	$750	--	--	$750
Grit Removal	$750	$750	$750	$750
Fine Screening	--	$1,500	$1,500	--
Biological Reactor (Structural)	$4,375	$2,450	$3,850	$3,500
Biological Reactor (Mech, Elec, Ins)	$750	$500	$625	$500
Membrane Bioreactor Equipment	--	$3,500	$3,500	--
Blower Building	--	$2,250	$2,250	$1,500
Clarifiers	$2,000	--	--	$2,000
RAS/WAS Pump Station	$750	--	--	$750
Filters	$2,000	--	--	$2,000
Waste Washwater Pump Station	$500	--	--	$500
UV Disinfection	$1,000	$900	$900	$1,000
Sludge Thickening	--	$1,000	--	$1,000
Aerobic Digestion	--	$600	--	$600
Sludge Drying Beds	$750	$750	$750	$750
Plant Drain Pump Station	$500	$500	$500	$500
Site Development Costs				
Civil Work	$2,400	$1,600	$1,600	$2,000
Yard Piping	$1,000	$700	$700	$1,000
Operations Building	$400	$400	$400	$400
Power Supply & Standby Power	$1,000	$1,000	$1,000	$1,000
SCADA System	$500	$450	$450	$500
Project Elements Subtotal	**$20,200**	**$19,600**	**$19,500**	**$21,800**
Project Allowances				
General Project Costs	$1,000	$1,000	$1,000	$1,100
Engineering & Admin	$4,000	$3,900	$3,900	$4,400
Contingency	$5,100	$4,900	$4,900	$5,500
Project Allowances Subtotal	**$10,100**	**$9,800**	**$9,800**	**$11,000**
Relative Project Capital Costs	**$30.3**	**$29.4**	**$29.3**	**$32.8**

4.3.2 Operations and Maintenance Costs

Providing a meaningful estimate of O&M costs requires detailed calculations that are not warranted at this stage of evaluation. Rather, a reasonable estimates can be assumed for the various project elements, and adjustments made for the relative differences in those estimates for each alternative. Therefore, the O&M estimates used for the following evaluation should be used only for comparison of alternatives.

Comparative O&M costs were developed and net present values were calculated based on a 20-year life cycle incorporating the present value impact of annual O&M costs. **Table 4-9** presents cost estimating parameters used in the evaluation.

Table 4-9
Cost Estimating Parameters

Parameter	Value and Comment
Planning Period	20 years
Net Interest Rate	4%
Labor Cost (Burdened)	$150,000/year per full time equivalent
Electricity	$0.15 per kW-hr
Sludge Hauling Costs	$60 per ton

Table 4-10 presents the breakdown of comparative annual costs per alternative. The net present value is presented at the bottom of the table.

Table 4-10
Annual O&M Cost by Alternative in Thousands

	Alt 1 Ex. Aeration	Alt 2A HR MBR	Alt 2B Ex.A MBR	Alt 3 HR AS
Labor	$300	$300	$300	$300
Power	$210	$300	$240	$220
Sludge Disposal	$60	$60	$60	$60
Maintenance	$480	$780	$720	$540
Total Annual O&M Cost	**$1,050**	**$1,440**	**$1,320**	**$1,120**
20-year Life Cycle Costs	**$14.3**	**$19.6**	**$17.9**	**$15.2**

4.3.3 Cost Comparison Summary

The comparative total net present value project costs are presented in **Table 4-11**. The differences in the comparative initial capital and O&M costs, however, are not large compared to the precision of the cost comparison. Although Alternative 2B - Extended Aeration MBR alternative has a lower initial capital cost than Alternative 1 - Conventional Extended Aeration, the 20-life cycle costs of all the alternatives is essentially the same given the precision of the estimate.

Table 4-11
Total Comparative Project Costs for Phase 1 Facility by Alternative (million $)

	Alt 1 Ex. Aeration	Alt 2A HR MBR	Alt 2B Ex.A MBR	Alt 3 HR AS
Initial Capital Costs	$30.3	$29.4	$29.3	$32.8
Net Present Value of O&M Costs	$14.3	$19.6	$17.9	$15.2
Relative Project Life Cycle Cost	$44.6	$49.0	$47.2	$48.0

4.4 MATRIX COMPARISON OF TREATMENT ALTERNATIVES

Each of the four alternatives were compared against each other using weighted criteria. This method involves three steps:

1. Establish a set of criteria and assign a weight to each criteria based on level of importance to the District. The total of the criteria weights should be equal to 100%.

2. Score each of the alternatives on a scale of 1 – 10 for each criteria.

3. Multiply each score by the corresponding weights; those products are then added together to give a total weighted score for each alternative.

The list of criteria for the matrix evaluation of the treatment alternatives are listed in **Table 4-12** along with the criteria weighting.

Table 4-12
Criteria Weighting

Criteria	Weight
Low Initial Capital Cost	15%
Low O&M Cost	35%
Small Footprint	5%
High Treatment Reliability	15%
Simple O&M	10%
Flexibility for Future	20%

The results of a weighted matrix evaluation of the four alternatives are shown in **Table 4-13**.

Table 4-13
Matrix Comparison Results for Treatment Alternatives

Treatment Alternative	Weighted Score	Dif.
Alternative 1 – Extended Aeration	6.85	98%
Alternative 2A – High Rate MBR	5.90	84%
Alternative 2B – Extended Aeration MBR	7.00	100%
Alternative 3 – Conventional Activated Sludge	5.35	76%

4.5 RISK ASSESSMENT OF TREATMENT ALTERNATIVES

The comparison described above is based on the expected performance requirements, site conditions, and other assumed factors. In reality, the project faces a number of risks that are not directly addressed in the comparison. **Table 4-14** lists a number of risks, and which alternatives would be less impacted by them.

Table 4-14
Treatment Alternative Risk Assessment

Risk	Likelihood	Impact	Preferred Alternative(s)
1. Geotechnical	Low	Med	2A- High Rate MBR 2B- Ex Aeration MBR
2. Material Cost Increases	Medium	Low	2A- High Rate MBR 2B- Ex Aeration MBR
3. Low Perc Rate/High Dilution Req	Low	High	None
4. Energy Availability	Medium	Med	1- Extended Aeration
5. Vendor Reliability	Low	High	1- Extended Aeration
6. Emerging Contaminants	Medium	High	1- Extended Aeration 2B- Ex Aeration MBR
7. Future Treatment Requirements	Medium	High	2A- High Rate MBR 2B- Ex Aeration MBR

1. **Geotechnical Risks –** A geotechnical investigation will need to be completed prior to the construction of a treatment plant. These unknown condition may influence the placement of the treatment facility on the site. Facilities with a large footprint have a higher risk that unfavorable geotechnical conditions will impact either the cost of the facilities or even the ability to build the facilities all together. The high rate and extended aeration MBR alternatives are the preferred alternatives when it comes to the risk associated with geotechnical issues due to the small footprint of these treatment trains.

2. **Material Cost Increases –** Facilities with big structures require large quantities of concrete and rebar for construction. The last decade has shown large relative increases in the cost of both concrete and steel. Such increases could increase the final bid cost for the project. Therefore, treatment trains with a small footprint and lower concrete requirement will reduce the risk associated with material cost increases. These treatment trains would be the high rate and extended aeration MBR alternatives.

3. **Low Percolation Rate/High Dilution Required –** One of the treatment processes is the percolation ponds used to recharge the groundwater basin. The percolation rate of the soils in the area is currently unknown as well as the amount of dilution water that would be required by the RWQCB. These two factors govern the size of the recharge basins which may require more land than previously thought. All treatment processes are subject to the risk of low percolation rates or a high dilution requirements.

4. **Energy Availability –** Technologies with greater energy demand have an increased sensitivity to increases in energy costs. The extended aeration alternative is least subject to this risk, due to the low energy requirement in comparison with the other alternatives.

5. **Vendor Reliability –** Technologies with proprietary equipment are susceptible to difficulties with the vendor which can have a direct impact on the project schedule and success. The extended aeration alternative is least subject to this risk, since this is a conventional technology without a lot of proprietary equipment.

6. **Emerging Contaminants –** Emerging contaminants including NDMA, personal care products and pharmaceuticals (PCPP) and disinfection by-products, while not currently regulated by RWQCB, could become regulated. Treatment processes with longer sludge ages provide a better level of treatment of PCPP. The extended aeration and extended aeration MBR alternatives are the preferred alternatives when it comes to the risk associated with emerging contaminants due to the longer sludge age.

7. **Future Treatment Requirements –** Future regulations may require treatment of wastewater effluent using reverse osmosis (RO) before recharging groundwater. If such a system is required it will need to be preceded by micro-filtration. MBRs use micro-filtration, so MBR effluent could go directly to RO without further treatment. The high rate and extended aeration MBR alternatives are the preferred alternatives when it comes to the risk associated with future treatment requirements.

Section 5
Unit Process Development

This section addresses the development of ten process units, and consists of the following technical memoranda.

- Technical Memorandum 5.1: Influent Pumping
- Technical Memorandum 5.2: Headworks
- Technical Memorandum 5.3: Bioreactors
- Technical Memorandum 5.4: Clarifiers
- Technical Memorandum 5.5: RAS Pump Station
- Technical Memorandum 5.6: Filters
- Technical Memorandum 5.7: UV Disinfection
- Technical Memorandum 5.8: Utility Water Pump Station
- Technical Memorandum 5.9: Percolation Ponds
- Technical Memorandum 5.10: Sludge Dewatering
- Technical Memorandum 5.11: Plant Drain Pump Station
- Technical Memorandum 5.12: Odor Control
- Technical Memorandum 5.13: Operations Building
- Technical Memorandum 5.14: Power Supply and SCADA

The technical memoranda listed above described the requirements for a 2-mgd treatment facility. Although Phase 1 will provide on a 1-mgd capacity, the second phase of construction is anticipated within a few years. Furthermore, the regulatory requirement to have standby capacity to ensure treatment reliability means that in many cases, the same facilities would have to be constructed even for 1 mgd. Of the facilities described in the memoranda for 2 mgd, the only difference would be that only one bioreactor is needed instead of two, and only four filter cells are needed instead of six.

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Technical Memorandum No. 5.1
Paxton Pump Station

The proposed sewage collection system will consist of a network of gravity sewers feeding the new wastewater treatment plant. Although the collection system will be by gravity, pump stations are required at several points in the system to lift sewage up to the treatment plant.

The main collection system pump station, Paxton Pump Station, will be located near Paxton Road and Balsa Avenue. The station receives flows west and south of the pump station. The discharge force main will extend approximately 5,000 feet to the Sunnyslope Trunk Sewer which provides gravity flow to the treatment plant.

PERFORMANCE REQUIREMENTS

Design Elevations

The Paxton Pump Station must lift sewage from a lower collection system to a higher collection system able to gravity flow into the treatment plant headworks (described in Technical Memorandum 5.2) without surcharging the sewers and preventing any sewage spills. The design elevations for the Paxton Pump Station are summarized in **Table 5.1-1**.

Table 5.1-1
Paxton Pump Station
Design Elevations

Parameter	Units	Value
Influent Sewer 1 (Yucca Wash)		
Invert Elevation	feet	3183.0
Diameter	inches	24
Influent Sewer 2 (Balsa Ave)		
Invert Elevation	feet	3185.0
Diameter	inches	10
Discharge Elevation	feet	3259.75

Flow Requirements

The collection system consists of pipes at moderate to steep grades. In sewers with low slopes, a substantial volume of sewage can be held in the pipe by increasing the depth of the sewer. This volume can be used to dampen peaks and spread instantaneous peaks over a longer period, up to a few hours. Given the relatively steep grades of the new sewers, however, any increases in depths in the sewers could rapidly result in sewer overflows close to the Paxton Pump Station.

For this reason, the Paxton Pump Station collection system should be able to handle peak instantaneous flows.

Based on the peak flow factors discussed in Section 2, the peak influent flows associated with each expansion are shown in **Table 5.1-2**. At buildout, approximately 1 mgd flows by gravity to the plant, and not through the Paxton Pump Station.

**Table 5.1-2
Paxton Pump Station
Flow Requirements**

Parameter	Units	Value
Design Average Flow		
Phase 1	mgd	1.0
Phase 2	mgd	2.0
Ultimate	mgd	5.0
Peak Hour Flow		
Phase 1	gpm	2,100
Phase 2	gpm	4,200
Ultimate	gpm	10,400
Instantaneous Peak Flow Factor	---	3
Minimum Flow Factor	---	0.5

Further Design Considerations

Design considerations for the new Paxton Pump Station include prevention of grit settling, prevention of scum accumulation and provisions for pump maintenance and removal. The Paxton Pump Station must also be designed for containment of odors with ventilation to an odor control system. The odor control system is described in Technical Memo 5.12.

The depth of the wetwell is based on an estimated invert elevation of the influent sewers provided in the Sewer Master Plan.

PROCESS DEVELOPMENT

Pump Type Selection

Submersible pumps were chosen as the pump type since they require a smaller structure and are available in a wide range of sizes.

Wet Well

With submersible pumps, it is not necessary to dewater the pump wet well to remove a pump so isolation is not required for each pump. To combat the accumulation of grit and grease in the wet well, a self-cleaning trench-style wetwell was chosen. In a trench-style configuration the submersible pumps are confined in a narrow trench in line with, but substantially lower than, the upstream inlet pipe. For self-cleaning in a trench-style wetwell, the wetwell is configured to have a curved ramp from the inlet pipe invert to the wetwell floor. This allows a hydraulic jump to be periodically created along the wetwell floor through control of the influent flow that scours grit and entrains scum to be pumped out.

The wet well will also be designed with access hatches and pump guide rails for pump removal. Removal of the pumps will require a portable crane or truck-mounted crane.

Odor Control

The detention time in the force main in the absence of oxygen will result in the generation of hydrogen sulfide. When released from the force main, the hydrogen sulfide is released into the atmosphere causing odors and corrosion to unprotected concrete. Ferric chloride can be added to the sewage at the pump station to bind the hydrogen sulfide. Therefore, a ferric chloride storage and feed station is included at the pump station.

DESIGN DESCRIPTION

Expansion Staging

Typically, wastewater facilities are built with provisions to expand capacity in the future with the addition of process units. For example, one clarifier may be needed for initial flows; when additional capacity is required, additional clarifiers are added in parallel. With collection system pump stations, the addition of parallel process units is problematic. Stations must be designed to avoid stagnant water which would allow grit and scum to accumulate in the wet well. Also, taking an influent wet well out of service to add additional units is difficult since the flow of sewage can not be stopped.

To address expansion issues, the pump station will be expanded in multiple stages. The pump station will initially be constructed with a single wetwell. As part of the Phase 3 expansion, a second wetwell and discharge line will be constructed. This approach allows better optimization of the initial facilities and the construction of a parallel system minimizes down time during expansion.

A layout drawing of the Paxton Pump Station is included in Volume 2. The expansion staging is summarized in **Table 5.1-3**.

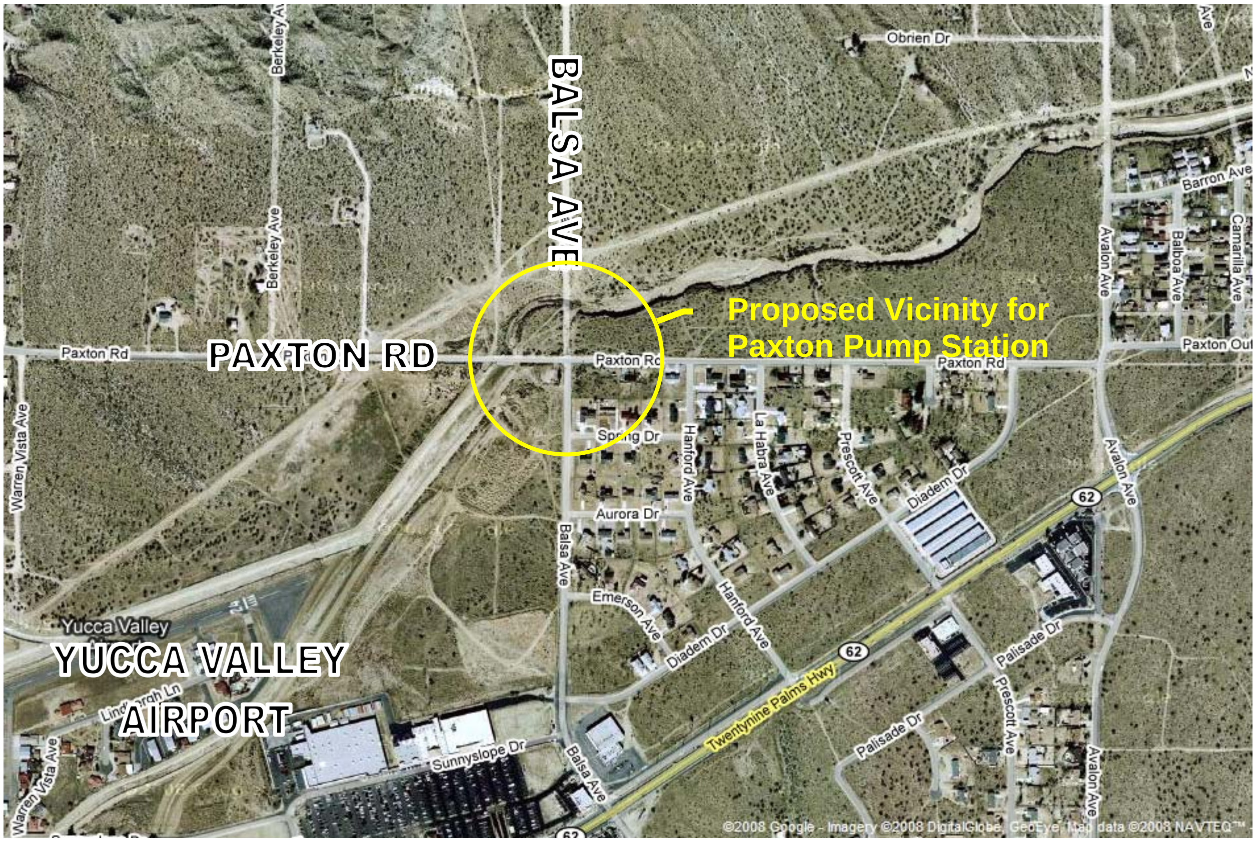
Table 5.1-3
Paxton Pump Station
Expansion Staging

Parameter	Phase 1	Phase 2	Phase 3-Ultimate
Number of Wetwells	1	1	2
Number of Pumps			
1,400 gpm	2+1	3+1	3+1
2,100 gpm	0	0	3+1
Discharge Force Mains			
Force Main 1 (18 inch)	X	X	X
Force Main 2 (18 inch)			X
Odor Control Facility			
Dosing Pumps	10 gph (1+1)	10 gph (1+1)	10 gph (3)
Storage Tanks	1-7,500 gall	1-7,500 gall	1-7,500 gall
			1-10,000 gall

Site Development

The Paxton Pump Station will be located remote from the treatment facility. Therefore, in the early collection system design phase, a parcel must be identified that will be suitable for the pump station and associated odor control and electrical facilities. The land around the proposed pump station location is largely undeveloped as shown in **Figure 5.1-1**. A proposed generic site layout for the Paxton Pump Station is included in Volume 2. The layout will require modification once a specific parcel is selected.

Figure 5.1-1
Proposed Paxton Pump Station Location



CONTROL DESCRIPTION

Given the large range of flows between initial minimum flows and design peak flows, the use of on/off pumping is not recommended. Variable speed drives provide much more consistent flow through the collections systems and to the wastewater treatment plant, and reduce the development of grit, scum and odors in the pump station wetwell.

Pump Controls

The pumps are controlled to maintain a constant level in the Paxton Pump Station. An ultrasonic level sensor monitors water level in the wet well and transmits it to the PLC. The PLC then activates and deactivates influent pumps, and controls their speed to maintain a setpoint level.

Each pump is provided with a variable frequency drive. Each drive is provided with a hand-off-automatic (HOA) selector switch. In the Off mode, the drive does not operate and the pump does not run.

In the Hand mode, the pump runs, unless the low-low level float switch is activated. The low-low level float switches are wired directly to the VFD controls for each pump. Since it is periodically necessary to run the level in the pump bay down to remove accumulated grit and grease, a low-low level override selector switch is provided for each pump. When selected, the pump continues to run, even in the event of a low-low level.

A control station with a Hand/Off/Remote (HOR) switch is located at each pump. The Hand and Off positions are as described above. When the switch in Remote, control is deferred to the VFD.

In Remote Manual Mode, an operator can manually start and stop the pumps and control the pump speed. The cleaning cycle for the wetwell should be performed weekly and generally in Remote Manual Mode. Before a cleaning cycle is initialed, influent flow should be around 1.0 mgd. To initiate the cleaning cycle, the operator slowly brings the speed of all pumps other than the last pump to zero. The low-low level override is then activated by the PLC before the pump-down begins. Once only the last pump is operating, the pump speed is increased until the pump loses prime. The pump speed is then reduced to zero and the normal operation is resumed. In the event of heavy grit or rag accumulation, the cleaning cycle may be repeated.

In Remote Automatic Mode the pumps are controlled by the PLC based on the level in the wetwell. The logic shown in **Table 5.1-4** will be used by the PLC in controlling the pumps.

Table 5.1-4
Paxton Pump Station Control Sequence

Level	Detected By	Action
High-High Level	Center Channel Float Switch	Initiate alarm, activate both pumps in auto mode at full speed.
High Level	Ultrasonic Meter	Activate Lag Pump
Normal	Ultrasonic Meter	Modulate speed of both pumps to maintain level
Low Level	Ultrasonic Meter	Deactivate Lag pump
Low-Low Level	Float Switch	Deactivate lead pump (unless low-low level float override is selected)

POWER SUPPLY

Power Demands

A listing of power demands is shown in Error! Reference source not found..

Table 5.1-5
Power Demands (Phase 2)

Equipment	Load	Drive Type	Number on Standby Power
Submersible Pumps (3+1)	85 hp	VFD	2
Biofilter Fans (1+1)	15 hp	starter	1
Ferric Dosing Pumps (1+1)	10 hp	VFD	1
Operations and Maintenance Bldg, Lighting, Controls, Power Tools	5 kVA	circuit bkr	1

Standby Power Provisions

To maintain basic pumping capacity in the event of a power failure, standby power for the submersible pumps is recommended as a minimum. Although the remaining pump station equipment does not require standby power, it represents only a small fraction of the total load. Provisions can be made to separate the loads so that standby power is only provided for essential loads. This can be accomplished by providing separate MCCs, or by providing control interlocks to turn off non-essential loads during power outages. Both solutions involve additional expense and complications that may or may not be offset by a reduction in the size of the standby generator.

For this facility, most of the normal power demand is essential and would have to be powered by the standby generator. Given the small difference in demand between the normal power demand and the demand during a shutdown, the expense and complications of separating essential and non-essential loads is not warranted.

A diesel-engine generator will be provided for standby power. The standby generator will be located in a room adjacent to the electrical room. An above-ground, double-walled diesel-fuel storage tank will be provided. The standby generator will start automatically on a loss of utility power. An electronically-interlocked tie-breaker would be provided to transfer the electrical supply from the utility feed to the standby generator when the power failed. The same tie-breaker would transfer the load back to the utility after the power failure ended. A low level switch will be provided in the fuel storage tank to indicate when the fuel storage tank volume is low. The low level switch will be monitored by the SCADA system.

Housing for Electrical Equipment

Variable frequency drives (VFDs) will be used for the submersible pumps. VFDs typically are rated to operate at a maximum ambient temperature of 40ºC (104ºF) or 50º C (122 degrees F). Without air conditioning, however, the rooms in which they are installed can easily rise above these temperatures in the summer, which could cause failure of the key process equipment. Therefore an electrical room will be provided with air conditioning sufficient to remove the heat generated by the VFDs at the design peak temperature day. MCCs require either a weather-proof enclosure for outside installation, or NEMA 1 or NEMA 12 enclosures in a building. Since an electrical room will be constructed to house the VFDs, the MCCs will also be included in this structure.

Future Expansion Considerations

Provisions must be made in the design for the installation of future electrical equipment, and all associated conduit and wiring into and out of the electrical room. These provisions can include spare conduits and wiring trenches. A new electrical room will be constructed for expansions past Phase 2.

SCADA SYSTEM

The PCIS (Process Control and Instrumentation System) will be designed for a high level of automation, requiring minimal operator intervention under normal conditions. The Paxton Pump Station PCIS will use the same platform and design philosophy as the Water Reclamation Facility (WRF). The pump station will be capable of running with no operators on-site, with remote monitoring and operations from the District Headquarters or the WRF. An HMI (Human-Machine Interface) is the operator interface that provides a graphical interface between the operator and the equipment. The HMI also provides alarm logging, trending, and historical database logging. The HMI application program will run on redundant HMI computers (workstations). A workstation will be located in the electrical room.

A UPS system will be provided in the electrical room to ensure that all key instrumentation, control, and communications hardware remain functional during a utility power outage for a minimum of two hours. All UPS units will be of the true double-conversion type to provide power noise protection. UPS status will be monitored from the SCADA system.

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PERFORMANCE REQUIREMENTS

The headworks must perform three basic functions:

- Remove large and stringy objects from the raw wastewater.
- Remove heavy and abrasive particles (grit).
- Split flow between pairs of oxidation ditches.

Table 5.2- 1 summarizes the performance requirements for the headworks and grit chamber.

Table 5.2- 1
Headworks and Grit Chamber
Performance Requirements

Parameter	Units	Value
Design Average Flow		
Initial	mgd	2.0
Ultimate	mgd	6.0
Peak Flow		
Initial	mgd	6.0
Ultimate	mgd	18.0
Screening		
Type		Bar Screen
Maximum Opening Size	inches	1/2
Grit Removal		
Type		Vortex, Non-Aerated

PROCESS DEVELOPMENT

Type of Bar Screen

There are a number of styles of bar screen used for raw wastewater. Given the success as well as widespread use in the industry, the climber type will be specified for this project. This type of bar screen consists of a series of vertical bars, evenly spaced, for removal of rags, branches, and other large objects. A mechanically activated rake arm removes screenings from the bar screen and discharges them to a conveyor. The screenings are conveyed to a screenings washer and compactor provided as part of the screenings system. The washer helps to control odors while the compactor decreases the volume of screenings for disposal.

Screenings Handling

Screenings removed from the flow stream by the bar screen are typically odorous and can contain a substantial amount of fecal material. The organic and fecal materials, which cause the odors, also comprise substantial amounts of water, which can create a problem when hauling the screenings for disposal.

To address the odor and disposal problem, a screenings washer is proposed. The washer will agitate the screenings in a water solution to remove a substantial portion of the organic material. A compactor designed to work with the screenings washer system will dewater, compact, and convey the screenings to a dumpster for disposal.

Number of Bar Screens

When the headworks is placed into service, the average flow will be approximately 2 mgd. Ultimately, the headworks will need to treat an average flow of 6 mgd, with peaks as high as 18 mgd. If all of the equipment were installed now for the ultimate peak flow, there would be significant problems with low velocities in the bar screen channels, and the grit deposition associated with low velocities.

A total of 3 mechanical screens and one bypass coarse screen will ultimately be provided. To address the problems associated with a large variation between initial average and ultimate peak flows, three of the four ultimate channels will be constructed. Two channels will have a mechanical bar screen and one channel will be equipped with a manual bar rack in the event that a mechanical unit is out of service for maintenance or repair. Each channel will be equipped with gates on both the upstream and downstream side of the bar screens for isolation. Knock-out walls will be provided for construction of the fourth channel.

Need for Grit Removal

Grit in the raw sewage is always removed prior to discharge from the treatment plant; the only question is where. Without grit removal at the headworks, grit will settle and accumulate in the piping to the oxidation ditch and in the oxidation ditch itself. Grit settlement in the oxidation ditch is not a major problem as long as the ditch can be taken out of service periodically (every few years) for manual removal of the grit. In this case, however, only one oxidation ditch will be constructed, and that can not be taken out of service. Therefore, it is recommended that grit removal be provided at this time. The additional operating cost of grit removal is offset by avoiding the need to manually remove grit from the oxidation ditches.

Grit Chamber

Since the process downstream of the headworks is the anoxic tank, the use of an aerated-type grit chamber is not appropriate. Instead, a vortex-type, non-aerated grit chamber is proposed.

One 16-foot diameter grit chamber is proposed for the treatment facility. While the 16-foot diameter has greater capacity than is initially required, the incremental cost to provide a grit chamber suitable for ultimate flow conditions is relatively low. The slight increase in initial capital cost will be offset by not requiring provision for the addition of a second grit chamber in the future.

Grit Conveyance and Handling

Grit removal from the grit chamber central hopper will be provided using horizontal recessed impeller pump. This type of pump is preferred since these pumps would be located at the invert elevation of the grit hopper. Providing a straight suction pipe from the grit hopper to the pump suction point will minimize clogging. Also, agitation water or air can be injected at the grit hopper before the pump runs to loosen the accumulated grit. In this facility, agitation water is preferred over air, since an air supply is not otherwise required, and the air will add dissolved oxygen to the process stream, which is adverse to denitrification.

The grit pumps will convey the grit slurry from the grit chamber hopper to a grit classifier. The classifier will consist of a cyclone type separator for grit separation and a helical-screw type classifier for final grit washing and dewatering. The dewatered grit will be discharged to a self-dumping hopper and taken off-site for disposal.

Flow Splitting

Flow will be ultimately split at the headworks using three pipes, each pipe will feed a pair of oxidation ditches. When the pipe reaches a pair of oxidation ditches the pipe will connect to a flow splitter structure. This structure will use gates to evenly distribute the flow between the pair of oxidation ditches.

DESIGN DESCRIPTION

A layout drawing of the headworks is included at the end of this Technical Memo. The design configuration is summarized in **Table 5.2- 2.**

Table 5.2- 2
Headworks
Design Configuration Study

Parameter	Units	Value
Bar Screen Channels		
Width	ft	2.5
Depth at Peak Flow	ft	1.83
Mechanical Bar Screens		
Initial	no.	2
Ultimate	no.	3
Grit Chamber		
Initial	no.	1
Ultimate	no.	1
Diameter	ft.	16
Grit Pumps		
Initial	no.	2 (1+1)
Type	----	Horizontal recessed impeller
Capacity	gpm	220
Grit Cyclones/Classifiers	no.	1

CONTROL DESCRIPTION

Bar Screen

The bar screens will be specified with a vendor furnished control panel. The control panel will activate both the bar screen rake mechanism, as well as the screenings washer and compactor. Water levels upstream and downstream of the bar screens will be monitored by a bubbler system. Although ultrasonic flow meters are preferred for level monitoring, the low head room available in the covered bar screen channels requires the use of bubblers.

Activation of a bar screen cleaning cycle can be initiated by high differential head across the screen, by a timer, or by a manual initiation.

Grit Chamber Mechanism

The grit chamber mechanism should run at all times. An on/off switch will be located at the grit chamber mechanism local control panel.

Grit Pumps

Each grit pump will be provided with a hand-off-automatic switch (HOA) located near the pump. In the off mode, the pump will not run. In the hand mode, the pump will run.

In the automatic mode, the pump will be started and stopped by the plant SCADA. In auto mode, one pump will be started and stopped on a repeat-cycle timer. At a set time interval prior to the pump starting (2-3 minutes), a solenoid will open to discharge agitation water into the grit hopper. The pump will then run for a set cycle and stop.

Grit Classifier

The grit classifier will have an HOA switch located at the unit. In Off mode, the unit will not run. In hand mode, the unit will run. In the auto mode, the unit will be started and stopped from the plant SCADA. In auto mode the classifier will start when the grit pumps are started, and shut the classifier off 5 minutes (programmable set point) after the grit pump turns off.

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The biological reactor provides suspended-growth, activated sludge treatment of raw wastewater. The reactor must accomplish the following treatment objectives:

- Reduce the biochemical oxygen demand (BOD) of the influent wastewater to no more than 10 mg/L
- Reduce total inorganic nitrogen (TIN) concentrations to less than 8 mg/L.

Talbe 5.3 -1 summarizes the performance requirements of the biological reactors.

Table 5.3- 1
Biological Reactors
Performance Requirements

Parameter	Units	Value
Design Average Flow		
Initial	mgd	2.0
Ultimate	mgd	6.0
Effluent BOD_5, 30-day average	mg/L	10
Effluent Total Inorganic Nitrogen (TIN), 30-day average	mg/L	8

PROCESS DEVELOPMENT

An extended-aeration, oxidation ditch is well suited for a facility such as this due to the following advantages:

- Operation is very simple since wastewater treatment and sludge stabilization occur in a single reactor.
- Due to the large amount of biomass and the long hydraulic detention time in the reactor, the process is not subject to rapid process upsets.
- The process does not generate a noticeable amount of odors.
- The aeration equipment consists of a motors, gear reducers, and a single-piece aerator device.

Although oxidation ditches are capable of reducing effluent nitrogen levels, the addition of an anoxic zone is warranted to ensure a consistent effluent TIN level of less than 8 mg/L. The anoxic zone is located upstream of the reactor. No aeration is provided, and nitrified mixed liquor from the oxidation ditch is recirculated. The combination of raw sewage, return activated sludge and recirculated nitrified mixed liquor promotes natural biological removal of nitrogen with no chemical additional required.

When anoxic zones were first installed upstream of oxidation ditches, mixed liquor was recirculated through the use of pumps located at the oxidation ditches. Since the recirculated flow is four times the average plant or more, the pumps and associated piping were very large. In recent years, a physical configuration developed by EIMCO for their Carousell process has been proven to be a more cost effective means of recirculation. The configuration uses the velocity in the oxidation ditch (1 to 3 feet per second) to recirculate flow through openings at one end of the ditch. The result is reduced construction and operating costs since pumps are not required. Also, increased recirculation ratios result in better denitrification.

DESIGN DESCRIPTION

A layout drawing of the biological reactor is included at in Volume 2. The design configuration of the oxidation ditch is summarized in **Table 5.3- 2.**

Each biological reactor consists of an anoxic tank and an oxidation ditch capable of treating 1 mgd average flow. Two reactors will be installed initially and share a common wall. At the 6-mgd ultimate capacity, the facility will consist of three pairs of biological reactors.

The oxidation ditch portion of the reactor is designed for a 25-day solids residence time based on a peak month loading of 3200 pounds of BOD_5 per day per mgd of base flow (384 mg/L) and a net yield coefficient of 0.80 pounds of total solids produced per pound of influent BOD_5. The net yield factor was based on the actual yield ratio of similar treatment facilities.

Table 5.3- 2
Oxidation Ditch Configuration Summary

Parameter	Units	Value
Oxidation Ditches		
Number	no.	2
Average Capacity, each	mgd	1.0
Aerobic Detention Time	hours	36
Solids Residence Time	day	25
Oxidation Ditch Dimensions		
Hydraulic Depth	ft	14
Volume (each)	mil gal	1.94
Oxygen Requirements (per Ditch)		
Actual Oxygen Requirements, peak hour	lb O2/hr	7,661
Alpha	---	0.95
Beta	---	0.90
Standard Oxygen Requirements, peak hour	lb O2/hr	13,699
Aerators		
Type	--	Slow-Speed Surface
Number (per Ditch)	--	2
Transfer Efficiency (@std. cond.)	lb/hp/hr	3.5
Transfer Capacity (each) (@ standard conditions)	lb O_2/hr	335
Power (each)	HP	165

Influent Feed

A single plant influent pipe from the headworks feeds each pair of oxidation ditches. Return activated sludge (RAS) is combined with plant influent upstream in a pipe upstream of the bioreactor. Influent mixed liquor is divided evenly in a splitter box located immediately upstream of the anoxic zones of each bioreactor.

Anoxic Tank

The anoxic tank provides denitrification where nitrate nitrogen is converted biologically to nitrogen gas in the absence of oxygen. A vertical mixer is furnished in the anoxic tank to prevent settling.

Oxidation Ditches

The oxidation ditches are provided with two slow-speed, vertical surface aerators. Each aerator is sized to provide the peak day oxygen demand, so only one aerator would run at any one time. The second aerator provides the required redundancy in case the first aerator is out of service.

The primary means of controlling the rate of oxygen transfer in the ditch will be through the use of variable speed surface aerators. Additionally, an manually adjustable effluent weir is provided to alter the range of water surface elevations in the ditch and thus the range of submergence of the aerators. This adjustment allows selection of the best submergence range for given influent flows and oxygen requirements.

CONTROL DESCRIPTION

Anoxic Tank Mixer

An HOA switch are located at the anoxic tank mixer. In “Off” mode, the mixer does not operate. In “Hand” mode, the mixer runs.

The following alarms conditions shut down the mixer and generate an alarm in the system:

- Motor winding temperature switch.
- Moisture detection relay. This relay requires a separate 110-volt power feed.

Oxidation Ditch Aerators

The aerators are VFD-driven to maintain a set point dissolved oxygen level in the ditch. An HOA switch is located near each oxidation ditch aerator. In “Off” mode, the aerator does not operate. In “Hand” mode, the aerator runs. In “Auto” mode the aerator are turned on and off by SCADA and the speed is adjusted based on dissolved oxygen levels in the ditch.

The following alarm conditions shut down the aerator and generate an alarm in the system:

- Motor winding temperature switch.
- Gearbox Low Oil Pressure Switch

Effluent Weir Gate

Each oxidation ditch has a manually-operated effluent weir gate. Under normal circumstances, the position of the gate is not changed. If the range of oxygen transfer rates accomplished by changing the aerator speed is too high or too low, the weir gate can be lowered or raised.

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The clarifiers separate suspended solids in mixed liquor to provide a high quality secondary effluent and a return activated sludge flow to the bioreactors. **Table 5.4- 1** summarizes the clarifier performance requirements.

Table 5.4- 1
Clarifier Performance Requirements

Parameter	Units	Value
Design Average Flow (Initial)	mgd	2.0
Peak Flow (Initial)	mgd	6.0
Surface Overflow Rate		
Average	gpd/sf	270
Peak	gpd/sf	761
Mixed Liquor Concentration	mg/L	4,000
Solids Loading Rate		
Average	lb/d/sf	16
Peak	lb/d/sf	38
Anticipated Effluent Quality		
TSS	mg/L	20
Turbidity	NTU	10
Sludge		
Density	% Solids	0.5-1.0

PROCESS DEVELOPMENT

Clarifier Configuration and Operation Contingency Plan

Ultimately the wastewater treatment plant will be equipped with six clarifiers, each designed for an average flow of 1 mgd. The corresponding six oxidation ditches will be operated in pairs, with each pair operated as a single biological system. A splitter structure is provided between the pair of oxidation ditches and the clarifier to divide flow from the two ditches evenly between the two corresponding clarifiers. If one clarifier is out of service, the flow from two ditches can be routed to the remaining in-service clarifier. Initially, two clarifiers will be constructed.

The secondary clarifier will be a circular 70-foot diameter clarifier with in-board launders, a plow-type collector, and scum trough. A scum pump station will be built at the clarifier with two submersible chopper-type pumps.

Scum Handling

Scum Collector

A scum collector is provided with the clarifier mechanism to force floatables, foam and grease toward a collection hopper. This hopper can consist of a tilting trough extending a portion or the entire radius of the clarifier, or of a small trough at the perimeter. For extended aeration processes, scum loading on the clarifier is not expected to be substantial, so the perimeter trough is recommended.

The clarifier is also provided with an Algae-Sweep mechanism which attaches to the scum collector and drive. The device consists of a set of brushes which ride along the effluent trough and weirs to prevent the accumulation of algae and other weeds on the weirs.

Scum Pumping

Scum can be pumped at each clarifier, or piped by gravity to a central scum pump station. The central scum pump station minimizes the number of pumps required, but also involves long runs of gravity scum pipes, which are highly susceptible to clogging with grease.

For this project, a simple pump station with duplex submersible chopper pumps is recommended at each clarifier. This configuration avoids the high capital cost of a central system which will not be needed for the other clarifiers for many years, and avoids the maintenance associated with scum suction lines.

The scum pumps will have a bypass back to the scum pit. This manually-actuated valve allows the discharge to spray on top of the scum wet well and emulsify the scum mat into the liquid being pumps. This feature is used periodically and performed manually.

Scum Disposal

At an extended aeration plant without separate sludge digestion, scum disposal options are limited. The disposal options are as follows:

- Return to Oxidation Ditch
- Pump to RAS line (which returns to oxidation ditch)
- Pump to Headworks.

The recommended configuration for scum pumping is to provide connections both to the biological reactors and to the headworks. The advantage of returning scum to the headworks is that any plastics which accumulate in the scum may be removed when passed through the bar screen at the headworks.

DESIGN DESCRIPTION

Layout drawings of the clarifier are included in Volume 2. **Table 5.4- 2** summarizes the design configuration of the clarifiers.

Table 5.4- 2
Clarifier Design Configuration, Initial Phase

Parameter	Units	Value
Number	---	2
Dimensions		
Diameter (to sidewalls)	ft	70
Depth	ft	14
Bottom Slope	in/ft	1
Scum Pumps		
Type	---	Submersible chopper
Number	---	2
Capacity (each)	gpm	120

CONTROL DESCRIPTION

Collector Mechanism

The collector mechanism runs at all times, unless the unit is being serviced or otherwise out of service. An on-off switch is located at the unit. The following alarm conditions are associated with the clarifiers:

- Overtorque Alarm. A torque indicator is provided with the collector mechanism. At a high torque, an alarm is generated at the plant SCADA screen at the local panel, but the collector remains in operation.
- Overtorque Shutdown. When the torque indicator indicates an even higher torque, the unit shuts down via a hard wired interlock, and a major alarm is generated at the plant SCADA screen at the local panel.

In addition to the controls, the drive mechanism has a shear pin to prevent the drive from damage in the event the overtorque shutoff does not function.

Scum Pumps

A vendor-furnished control panel, located at the associated clarifier drives each scum pump. The control panel houses the motor starters for the pumps.

The scum pumps is controlled by level, as sensed from float switches. The control panel is provided with outputs for pump status (Hand, Off or Automatic), and a single signal for an alarm condition. The plant SCADA system monitor equipment status and alarms.

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Technical Memorandum No. 5.5
RAS Pump Station

This technical memorandum covers the performance and design requirements for the RAS/WAS Pump Station.

PERFORMANCE REQUIREMENTS

The RAS Pump Station must accomplish the following functions:

- Transfer return activated sludge (RAS) from the clarifiers back to the oxidation ditches.
- Convey waste activated sludge (WAS) to the sludge dewatering process.

Table 5.5- 1 summarizes the performance requirements for the RAS Pump Station.

Table 5.5- 1
RAS Pump Station Performance Requirements

Parameter	Units	Value
RAS Flow		
Avg Return Rate (Percent of Avg flow)	%	90
Peak Return Rate (Percent of Avg flow)	%	150
WAS Flow	gpm	0-300

PROCESS DEVELOPMENT

RAS Pump Type

Due to their reliability and proven performance, horizontal, non-clog pumps are used for conveying RAS flow. To allow control over sludge return rates, and therefore sludge concentration, variable speed drives are required.

WAS Pump Type

The types of positive displacement pumps typically used to convey the WAS to sludge dewatering include progressing cavity and rotary lobe pumps. Rotary lobe pumps are relatively small in size and are adequate for pumping sludges of less than 1 percent, as is the case with WAS. Progressing cavity pumps are large and tend to be more expensive than rotary lobe pumps. Due to the smaller size and lower cost, rotary lobe pumps are recommended.

DESIGN DESCRIPTION

The RAS and WAS pumps are located near and will service two secondary clarifiers. The pumps must be located below grade to ensure a flooded pump suction at all times. When future clarifiers are constructed, a second pump station will be constructed. At ultimate capacity there will be one pump station associated with each pair of clarifiers.

Each pump station houses three 1,050-gpm RAS pumps, with two pumps in continuous service, and one pump operating in standby mode. Each RAS pump will be provided with a variable frequency drive (VFD) for speed control.

Two, 300-gpm rotary lobe WAS pumps will be installed in a one duty and one standby configuration. These two pumps will provide the necessary capacity for the initial phase.

Since the structure is located below grade, a sump with duplex sump pumps will be provided to remove any drainage, rain or washdown water from the pit.

A layout drawing of the RAS Pump Station is included in Volume 2. The design configuration is summarized in **Table 5.5- 2**.

Table 5.5- 2
RAS Pump Station
Design Configuration

Parameter	Units	Value
Return Activated Sludge Pumps		
Type	---	Horizontal Non-Clog
Drive	---	Variable Frequency
Number	---	3 (1+1)
Capacity, each	gpm	1,050
Waste Activated Sludge Pumps		
Type	---	Rotary Lobe
Drive	---	Variable Frequency
Number	---	2 (1+1)
Capacity, each	gpm	300

CONTROL DESCRIPTION

Return Activated Sludge Pumps

The RAS pumps are driven by a VFD unit. The speed of the VFD will be controlled to maintain a set point clarifier underflow rate. This underflow rate set point will be established in SCADA. In SCADA, the clarifier underflow rate can be set to a particular value, set as a fraction of influent flow (with bias), or according to a programmable schedule.

A hand-off-remote (HOR) switch is located at each pump. In the “Off” mode, the pump does not operate. In the “Hand” mode, the pump runs at the speed set at the VFD unit. In the “Remote” mode, the pump starts and stops automatically. Speed control is not be provided at the pumps themselves.

Two switches are located at each VFD panel. One switch selects between local and remote speed control. In local speed control, the speed of the VFD is set by a control on the VFD itself. In remote speed control, the speed signal is determined by SCADA. The second switch is an HOA selector. This switch controls the VFD only if the HOR at the pump is in the “Remote” position. With the VFD HOA switch in the “Automatic” position, the starting and stopping of the pump is controlled by SCADA.

The following pump protections will be provided:

- Motor winding temperature switch.

Waste Activated Sludge Pumps

The WAS pumps are driven by a VFD unit to control the pumping rate. A hand-off-remote (HOR) switch will be located at each pump. In the “Off” mode, the pump does not operate. In the “Hand” mode, the pump runs at the speed set at the VFD unit. In the “Remote” mode, the pump starts and stops automatically. Speed control is not be provided at the pumps themselves.

There are two switches located at each VFD panel, one for local speed control and the other for remote speed control. In local speed control, the speed of the VFD is set by a control on the VFD itself. In remote speed control, the speed signal is determined by SCADA. The second switch is an HOA switch. This switch only controls the VFD if the HOR at the pump is in the “Remote” position. With the VFD HOA switch in the “Automatic” position, the starting and stopping of the pump is controlled by SCADA.

The following pump protections will be provided:

- Motor winding temperature switch.
- High discharge pressure
- Low suction pressure (high vacuum)

Drainage Pumps

A vendor-furnished control panel, located at the pump station drives the drainage pumps. The control panel houses the motor starters for the pumps.

The drainage pumps are controlled by level, as sensed from float switches. The control panel is provided with outputs for pump status (Running, Off or Automatic), and a single signal for an alarm condition. The SCADA monitors equipment status and alarms.

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Technical Memorandum No. 5.6
Filters

This technical memorandum covers the performance and design requirements for the filters. The filters take secondary effluent from the clarifiers and pass the flow through a continuous backwashing, deep bed sand filters .

PERFORMANCE REQUIREMENTS

The purpose of the process is to provide a final polishing process to the biologically treated water; removing any unsettled floc, grit or other materials that may have escaped the secondary clarifiers. Provisions for chemical addition to assist in filtration as well as a filter backwash system are provided.

Table 5.6- 1 summarizes the performance requirements for the filters.

Table 5.6- 1
Filter Performance Requirements

Parameter	Units	Value
Design Average Flow	mgd	2
Design Peak Flow	mgd	6
Secondary Effluent Quality		
Total Suspended Solids (TSS)	mg/L	10
Turbidity	NTU	10
Filtered Effluent Quality		
Turbidity	NTU	<2

PROCESS DEVELOPMENT

Chemical Addition Facility

Proper filtration requires the addition of a flocculent that causes fine and colloidal particles into larger particles that become trapped in the moving-bed sand filter. Flocculation is typically accomplished with the addition of alum, polymer, or a mixture of the two called alumer.

Flow Split/Overflow Structure

At ultimate capacity, there will be three separate modules of filters. In order to minimize the headloss and distribute the flow evenly among the filter cells, large diameter pipes are utilized. A single pipe coming from the flash mix structure splits flow among the six filter cells in each module. The flow is by gravity, with the exact flow split to each of the cells governed by the weirs in the filter inlet structure upstream of each filter cell.

A fifth flow splitting structure provides a means to bypass the filter influent structures to the filter effluent in case of filter failure. This bypass prevents a blowout of the filter media in the event of a hydraulic overload.

Filters

Continuous backwashing, deep bed sand filters are used. The filter cell size and numbers is based on a filter loading rate of 5 gpm/sq ft at a peak hydraulic flow. With one cell out of service, the remaining 5 cells with a surface area of 200 square feet each would be required at the peak hourly flow.

Air Compressors

The moving-bed sand filters use air lift pumps to wash the sand media. The air is supplied by a compressed air system consisting of two air compressors (one duty plus one standby) and a receiver tank.

DESIGN DESCRIPTION

The filter system consists of the flash mix station, and filters. The filter system will be expanded in the future stages of construction through the addition of additional filter modules. Layout drawings of the filter system are included in Volume 2. **Table 5.6- 2** summarizes the design configuration of the filter system for the initial stage of construction.

Table 5.6- 2
Filters Design Configuration, Initial Phase

Parameter	Units	Value
Design Parameters		
Media Type	---	Sand
Media Depth	in	40
Peak Loading Rate	gpm/sq. ft	5
Number of Cells	---	6
Cell Area, each	sq ft	200
Filter Air Compressor		
Number	---	2
Capacity, each	hp	40

CONTROL DESCRIPTION

Control of the filter system is automated by the plant SCADA system. Control of the various functions will be provided at each to following locations:

- At each piece of equipment with a Hand-Off-Automatic (HOA) switch.
- Through a workstation connection to the SCADA system. A workstation is provided at the MCC nearest the filters.
- Through the Filter Control Panel.

Filter Control Panel

The intent of the filter control panel is to provide the operator with manual control for taking a cell out of service. The control panel will have the following controls:

- Cell Selector – when selected for a particular cell, the filter control panel will control the particular valves for that cell. If no cells are selected the panel will leave controls to the SCADA.
- Individual Valves:
    - Influent (open/closed)
    - Waste Backwash (open/closed)

Air Compressors

The air compressors are provided with a selector switch to identify which compressor is lead and lag. Each compressor is provided with an HOA switch located at the compressor. In Off, the compressor does not run. In Hand, the compressor runs. In automatic, the compressor is started and stopped through SCADA. The compressor is provided with the following alarms:

- High discharge pressure
- Motor overloads
- Low discharge pressure

Flash Mix Pump

The flash mix pump is intended to run at all times at full speed. An on-off switch is provided at the pump.

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Technical Memorandum No. 5.7
UV Disinfection

This technical memorandum covers the performance and design requirements for the effluent disinfection system.

PERFORMANCE REQUIREMENTS

The UV Disinfection facility must ensure a specific delivered dose. The delivered dose, specified below, must be verified by bioassay testing on a similar facility as required by the California Department of Public Health (CDPH) as described in the May 2003 NWRI UV disinfection guidelines for unrestricted reuse.

Table 5.7- 1 summarizes the performance requirements for the UV disinfection facility.

Table 5.7- 1
UV Disinfection Facility
Performance Requirements

Parameter	Units	Value
Design Average Flow	mgd	2
Design Peak Flow	mgd	6
Minimum Delivered UV Dose	mJ/cm^2	100
Minimum Transmittance	%	65
Effluent Total Coliform Concentration		
7-Day Median	MPN/100 ml	2.2
Instances exceeding 24MPN/100 ml	per month	1
Single sample	MPN/100 ml	240

PROCESS DEVELOPMENT

The manufacturer of the UV system should be decided through a separate selection process where competing systems are evaluated based on a life cycle comparison. This selection process should occur early in the detailed design, prior to the project going out to bid. Two manufacturers, Trojan and Wedeco, both have a DPH-approved open channel, low pressure, high output system. The Wedeco system requires a separate tank for cleaning of the UV lamps, where the Trojan system has an automatic cleaning system. Therefore the Trojan system has a smaller footprint and was used as the basis for pre-design planning.

DESIGN DESCRIPTION

The UV disinfection system consists of the UV channels, lamps and inlet/outlet channels. The UV system will be expanded in the future stages of construction through the addition of parallel channels. Layout drawings of the UV facility are included in Volume 2. **Table 5.7- 2** summarizes the design configuration of the UV disinfection facility system for the initial stages of construction.

Table 5.7- 2
UV Disinfection Facility
Design Configuration

Parameter	Units	Value
Channel Width	in	36
Channel Depth	in	51
Channel Liquid Depth, Avg	in	16
Channel Length	ft	62
Number of lamp banks in series	---	5
Number of module per bank	---	8
Number of lamps per module	---	4
Number of Channels	---	1

One UV channel is provided for the initial construction. Filtered effluent flows into an influent channel, where it flows over a fiberglass weir trough and through a slide gate. After passing through the slide gate the water encounters a baffle wall to create a uniform approach velocity to the first bank of lamps. The water then continues through the lamp banks. There will be five banks in the channel to be operated in a 4+1 fashion. Water exits the channel through a weighted swing gate, where it collects in a channel and to a pipe to the percolation ponds. The purpose of the weighted swing gate is to maintain a constant water level through the lamps. Both the inlet and outlet channels are constructed in the initial phase with a knockout wall that allows them to be expanded in the future. The UV disinfection system is covered by a canopy extending the length of the system with a minimum 8 feet of clearance above the walkway. Two remote input/output modules (RIOs) will be located near the UV system. One RIO will be supplied by the UV system supplier and connected to the UV system PLC, the other to the plant SCADA.

CONTROL DESCRIPTION

The UV disinfection system is controlled by a vendor-furnished programmable logic controller (PLC). The control system requires external inputs for UV influent flow and filter effluent turbidity. Based on this, the UV control panel determines the number of active banks to achieve the required UV dose. The vendor-furnished PLC will have a data link with the plant SCADA system to monitor the system status and alarms.

MWH — Technical Memorandum No. 5.9 Percolation Ponds

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PROJECT: Water Reclamation Facility

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Technical Memorandum No. 5.9
Percolation Ponds

This technical memorandum covers the performance and design requirements for the percolation ponds.

PERFORMANCE REQUIREMENTS

Treated effluent from the new reclamation facility is sent to the percolation ponds. **Table 5.9-1** summarizes the performance requirements for the percolation ponds.

Table 5.9-1
Percolation Pond Performance Requirements

Parameter	Units	Value
Design Average Flow	mgd	2.0
Peak Week Flow Factor	-	1.5
Design Peak Week Flow	mgd	3.0

PROCESS DEVELOPMENT

Space Availability

The first step of the percolation pond development was to determine the space available on site for percolation. The proposed percolation pond layout is shown on Drawing 00-2. The ponds are constrained on the west end of the site by the estimated boundary of the floodway. A detailed flood evaluation will be conducted as part of the design phase to determine this boundary.

Four ponds will be provided to allow one of the ponds to be periodically taken out of service during average flow conditions to till or scarify the bottom of pond to increase the percolation rate. The ponds will be constructed surrounded by a 16 foot road to allow for equipment access to the ponds.

Based on the site constraints and the desired configuration the pond sizes shown in **Table 5.9-2** were selected.

Table 5.9-2
Available Percolation Pond Area

	Length x Width	Area per Pond	Quantity	Total Area
Size 1	325 ft x 155 ft	50,375 ft^2	3	151,125 ft^2
Size 2	225 ft x 155 ft	34,875 ft^2	1	34,875 ft^2
			Total	186,000 ft^2

Size Requirements

The percolation ponds size requirements are based on peak week flows for a 2 mgd facility with all percolation ponds in service. For the purposes of designing the percolation ponds, a peak week factor of 1.5 times the average annual flow is assumed. For the initial evaluation and until site-specific percolation testing is completed, a maximum sustained percolation rate of 2 ft per day was assumed. The percolation pond area required with the assumed peaking factor and percolation rate is greater than the available percolation pond area. To achieve percolation with the available area the percolation rate would have to be great than 2.16 ft per day. It is believed that once the United States Geological Survey has finished the percolation testing the final percolation rate should be significantly great than 2 ft per day and, therefore, the available area should be sufficient.

Even though the percolation ponds are sized for the peak week flow, there must be some way to accommodate peak day flows. The percolation ponds were laid out with a depth of 5 ft. This includes 2 ft of operating depth, 2 ft of equalization depth and 1 ft of freeboard. In the event of a peak day event (peaking factor = 2.5) including rainfall (2 in/day), 1.76 ft of the 2 ft of equalization depth will be used.

DESIGN DESCRIPTION

Table 5.9- 3 summarizes the design configuration of the percolation ponds for the initial stages of construction in addition to the dimensions provided above in Table 5.9-2.

Table 5.9- 3
Percolation Ponds Design Configuration

Parameter	Units	Value
Total Number of Percolation Ponds	---	4
Total Required Ponds at Annual Average Flow	---	3

CONTROL DESCRIPTION

Flow from the new reclamation plant will be fed directly to the percolation ponds. During dry weather flow at least one pond will be out of service to allow the plant staff to scarify or till the bottom of the pond. During wet weather flow all basins will be required for service.

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Technical Memorandum No. 5.8
Utility Water Pump Station

This technical memorandum covers the requirements for pumping utility water within the plant.

PERFORMANCE REQUIREMENTS

Utility water is used within a plant site for various non-potable purposes such as seal water, foam spray, spray wash and plant water irrigation.

The utility water system demands that are anticipated for the initial and ultimate phase are summarized in **Table 5.8- 1**.

Table 5.8- 1
Utility Water Requirements

Parameter	Units	Initial Demand	Ultimate Demand
Biofilter Humidification	gpm	5	5
On-Site Irrigation	gpm	10	10
Sludge Dewatering	gpm	100	200
Hose Bibbs	gpm	40	80
Total Demand	gpm	155	295

PROCESS DEVELOPMENT

Filtered and disinfected effluent should be used to supply the utility water system. Disinfected effluent is fed from the UV system into a bay that runs the width of the utility water pump station. The water level in this bay is controlled by a weir on the south side of the bay. Any effluent not used by the utility water pumps flows over the weirs to the percolation ponds. A separate pipe with an manually-operated slide gate is provided for each percolation pone. The slide gate allows the operator to isolate specific ponds for maintenance purposes, such as scarifying the bottoms.

Three 100-gpm pumps will be installed in Phase 1. At peak demand, two pumps will operate with the third available as a standby pump. A fourth 100-gpm pump will be installed in the future.

DESIGN DESCRIPTION

The utility water pump station includes three pumps with space for a fourth at ultimate conditions. Layout drawings of the utility water pump station are included in Volume 2. **Table 5.8- 2** summarizes the design configuration of the utility water pump station.

Table 5.8- 2
Utility Water Pump Station Design Configuration

Parameter	Units	Value (Initial)	Value (Ultimate)
Number of Pumps	---	3	4
Capacity of Pumps	gpm	100	100

CONTROL DESCRIPTION

Flow from the UV system will be fed to the utility water pump station. A weir will be utilized to ensure that the level in the wet well is maintained to meet the utility water demands within the plant. All other flow will be sent to the percolation ponds. During dry weather flow at least one pond will be out of service to allow the plant staff to scarify or till the bottom of the pond. The flow to the ponds can be isolated using the gates at the utility water pump station.

Technical Memorandum No. 5.10
Sludge Dewatering

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Technical Memorandum No. 5.10
Sludge Dewatering

This technical memorandum covers the performance and design requirements for the solids handling facility.

PERFORMANCE REQUIREMENTS

The quantity of sludge, its concentration and volume are determined by a number of process units in the plant. To determine the total amount of solids to dewater a solids mass balance was prepared. The layout of the solids dewatering is included in Volume 2. **Table 5.10-1** summarizes the performance requirements for the sludge dewatering facilities.

Table 5.10-1
Belt Press Performance Requirements

Parameter	Units	Value
Feed Sludge Concentration		
Minimum	% dry solids	0.5
Maximum	% dry solids	1.25
Typical	% dry solids	0.8
Sludge Volume (at typical % solids)	gal/day	80,000
Solids Loading	lb/day	5,300
Minimum Solids Capture	%	95

PROCESS DEVELOPMENT

Belt Press

The belt press facility includes two 2-meter belt presses for sludge dewatering. One of the units provides standby dewatering capacity when the other requires servicing. The belt press is designed to be operated 8 hours per day, five days a week.

Polymer System

The polymer system consists of two polymer mix-feed units. These units combine neat polymer and utility water to supply an activated polymer solution for feed sludge conditioning. The polymer solution gear pumps transfer the polymer to the belt press sludge feed lines.

Filtrate Sump Drainage

Belt press filtrate and belt wash water flow from the belt press down into a drainage trench near the belt presses. This trench is drained by two 4-inch floor drains which will feed into a common 6-inch plant drain line, and drain to the plant drain pump station.

Building

Because belt presses require sheltering from sun and wind, they should be located in an enclosure. Metal or wood buildings are not suitable for housing belt presses due to the humidity associated with sludge dewatering. The recommended building material as concrete block masonry. A mezzanine is required above the ground level to provide operational access to the top of the belt presses.

Odor Control

Waste sludge from the proposed extended aeration process has little or no odor, so odor control in the sludge dewatering building is not recommended. Ventilation should be provided, however, to limit humidity in the building.

DESIGN DESCRIPTION

The solids handling system consists of the belt press, belt wash water booster pumps, conveyors, sludge hopper, truck loading station and polymer solution system. Layout drawings of the solids handling system are included in Volume 2. **Table 5.10-2** summarizes the design configuration of the solids handling system for the initial stages of construction.

Table 5.10-2
Belt Press Design Configuration

Parameter	Units	Value
Belt Presses, 2 meter	---	2
Belt Press Performance Criteria		
Hydraulic Loading Rate	gpm	300
Solids Loading Rate	lb/hr	1,000
Polymer Mix Feed Unit		
Number	---	2
Size, each	hp	1/2
Belt Wash Water Booster		
Number	---	2
Capacity, each	gpm	80

CONTROL DESCRIPTION

Belt Press Control Configuration

The belt press control system must control the following operational parameters:

- Select which WAS pump is to feed the belt press.
- Start and stop WAS pump selected to feed the belt press.
- Set flow rate set-point of WAS pump feeding belt press.
- Start and stop polymer solution pump for each belt press.
- Start and stop sludge conveyor
- Activate and deactivate belt wash booster pump station
- Start and stop belt conveyor
- Start and stop belt drive
- Start and stop belt tracking
- Start and stop belt tensioning system
- Open and close washwater solenoid valve.

To control these function, a PLC is furnished by the belt press vendor. The PLC controls the belt presses and provides all control interface requirements. The PLC is networked for monitoring by the plant SCADA system.

MWH

Technical Memorandum No. 5.11
Plant Drain Pump Station

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Technical Memorandum No. 5.11
Plant Drain Pump Station

This technical memorandum covers the performance and design requirements for the plant drain pump station.

PERFORMANCE REQUIREMENTS

The plant drain pump station collects waste flows from the filters, the sludge dewatering building, and other miscellaneous plant drains on the site. The flow is then pumped back at a controlled flow rate to the headworks. The plant drain should is returned downstream of the plant influent flow metering and sampling.

The plant drain pump station is sized to handle flow from the belt press and the filters. **Table 5.11- 1** summarizes the flow rate that the plant drain pump station will need to handle.

Table 5.11- 1
Plant Drain Pump Station
Design Flows

Parameter	Units	Value
Backwash Flows	gpm	300
Sludge Filtrate Flows	gpm	250
Belt Press Wash Water Flows	gpm	100
Miscellaneous Flows	gpm	50
Total Flows	gpm	700

PROCESS DEVELOPMENT

The plant drain pump station will be sized to handle flow from the belt press and the filters with one filter out of service. The pump will be operated in a 1+1 fashion during the initial stages with the ability to add a third pump as the flow increases.

DESIGN DESCRIPTION

The plant drain pump station will consist of three submersible non-clog pumps located in a single square wet well. Layout drawings of the plant drain pump station are included in Volume 2. **Table 5.11- 2** summarizes the design configuration of the plant drain pump station.

Table 5.11- 2
Plant Drain Pump Station
Design Configuration

Parameter	Units	Value
Wet Well Dimensions		
Length	ft	10
Width	ft	10
Depth	ft	23
Working Depth	ft	5
Number of Pumps	---	2 (1+1)
Capacity of pumps, each	gpm	440

CONTROL DESCRIPTION

The plant drain pump station will pump back to the front of the plant at the bar screens. The pumps will be constant speed pumps and will start/stop based on the level in the wet well. There will be an LIT and four level switches, low-low will shut off the pumps, low will start one pump, high will start one of the other pumps and high-high will send an alarm to the plant SCADA system.

MWH	Technical Memorandum No. 5.12 Odor Control

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PERFORMANCE REQUIREMENTS

Of the proposed treatment facilities, two are likely to generate odors; the Paxton Pump Station and the headworks. The waste activated sludge being handled in the Sludge Dewatering Building is aerobically stabilized and will not generate significant odors.

Paxton Pump Station

The Paxton Pump Station is located in the vicinity of Paxton Road and Balsa Avenue, and is in effect the main influent pump station for the treatment plant. The Paxton Pump Station is described in Technical Memorandum 5.1. The influent pump station ventilation rate is based on the greater of two criteria. First, enough ventilation must be provided to change the entire air volume in the wet well 12 times per hour. Second, the ventilation rate must be at least as much as the air flow rate coming from the influent sewer. Air flow in the sewer is induced by the velocity of the sewage and flows in the same direction as the sewage. The intent of both criteria is to maintain a negative air pressure in the pump station, so that odors in the wet well do escape.

Headworks

The headworks is a likely source of offensive odors at the treatment plant. Specific sources of odors include:

- The sewage water surface, particularly at any points of turbulence such as the bar screens and splitter weirs.
- The screenings removed from the influent sewage.
- The grit removed from the influent sewage.

Table 5.12- 1 summarizes the performance requirements for the odor control facility.

Table 5.12- 1
Odor Control
Performance Requirements

Parameter	Units	Value
Paxton Pump Station Ventilation Criteria		
Exchange Rate	air changes/hr	12
Influent Sewer Air Velocity	ft/s	4
Ventilation Rate Required	cfm	1,200
Headworks Ventilation Criteria		
Channels and grit chamber	air changes/hr	12
Bar screen enclosures	air changes/hr	12
Dumpster Enclosures	air changes/hr	12
Opening face velocities	ft/min	2,050
Foul Air H_2S Concentrations		
Average	ppmv	25
Peak	ppmv	20
Maximum discharge H_2S Concentration	ppm	0.2

PROCESS DEVELOPMENT

In wastewater treatment plants, several types of odor control technologies have been employed, including chemical scrubbers, biological scrubbers, activated carbon and biofilters. Biofilters are able to treat a large variety of odorous compounds including volatile organic carbons. It is a simple technology with minimum moving parts and low energy requirements. The indigenous bacteria and other microorganisms in the media acclimate to the compounds present and are sufficient to provide the "scrubbing" action without any bacterial inoculation or chemical addition, which is required by biological and chemical scrubbers respectively. Cold winter temperatures do not affect biofilter performance. Biofilters have a low profile and are not as visible to neighbors as a system requiring a stack. The biofilters also require the largest footprint.

DESIGN DESCRIPTION

The odor control facility will consist of the odor control fan, the biofilters and the drainage system. Given the configuration of the site, the influent pump station will have a separate odor control facility off-site. Layout drawings of the odor control facility are included in Volume 2.

Headworks

The headworks will be provided with a biofilter and two odor control fans. Each fan will have a capacity of 1,025 cfm and will be operated in a 2+0 fashion. **Table 5.12-2** summarizes the design configuration of the odor control facility for the Headworks.

Table 5.12-2
Odor Control Facility - Headworks
Design Configuration

Parameter	Units	Value
Ventilation Rate	cfm	2,050
Biofilter Loading Rate	cfm/sq ft	4
Width	ft	23
Length	ft	23
Total Active Area	sq ft	529
Type of Media	---	Wood chips
Depth of Media	ft	4

Paxton Pump Station

The Paxton Pump Station will be provided with a biofilter and two odor control fans. Each fan will have a capacity of 600 cfm and will be operated in a 2+0 fashion. **Table 5.12-3** summarizes the design configuration of the odor control facility for the IPS.

Table 5.12-3
Odor Control Facility - IPS
Design Configuration

Parameter	Units	Value
Ventilation Rate	cfm	1,200
Biofilter Loading Rate	cfm/sq ft	4
Width	ft	17
Length	ft	17
Total Active Area	sq ft	289
Type of Media	---	Wood chips
Depth of Media	ft	4

Common Design Elements

Odor Control Fans

Foul air will be collected in a header. This header will join a common header that connects to two fans. Two fans will be installed during the initial construction phase and will be operated with no standby. If one fan fails, minimum ventilation can be maintained with the remaining one fans. Odor control fans are typically very reliable. The three fans will operate concurrently for the majority of the time. Just downstream of the fan an injection pipe with a fine mist nozzle spraying utility water to saturate the air. The air going to the biofilter should be saturated with moisture to facilitate the biological growth in the filter media and prevent media drying which leads to ineffective treatment.

Biofilters

The biofilters are constructed above ground with three sides constructed of removable barriers for easier media replacement. The fourth side is a concrete wall. The fans distribute foul air to the distribution pipes. Each of the pipes is partially embedded in the asphalt floor of the biofilter and covered with media. The floor of the biofilter is sloped to a trench drain, which collects any condensation and routes it to the pump station wet well at the Paxton Pump Station, or the Plant Drain Pump Station for the Headworks. The biofilter is equipped with an irrigation system to maintain the appropriate moisture content within the media.

Drainage System

Excess moisture collected in the fan discharge piping drain into a trap drain, since the air is at a higher than atmospheric pressure. The hydrogen sulfide in the foul air will oxidize in the biofilter to sulfuric acid, making the head space above the liquid highly corrosive.

CONTROL DESCRIPTION

The odor control fans are intended to operate in a 2+0 fashion during the initial stages of construction. An on-off switch will be located at each fan. A flow meter will be installed in the duct work between the fan and the biofilter to measure flow. The meter will transmit to the plant SCADA. An alarm will be generated if the air flow rate drops below a certain set point value.

CLIENT: Hi-Desert Water District

PROJECT: Water Reclamation Facility

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Technical Memorandum No. 5.13
Operations Building

This technical memorandum covers the performance and design requirements for the operations building.

PERFORMANCE REQUIREMENTS

The operations building performance requirement include laboratory space, plant control, and monitoring, employee facilities and maintenance facilities.

Laboratory

Typically, for small and especially new small plants, most analytical laboratory work is contracted to private laboratories or other agencies. Laboratory space is typically provided, however, for operators to conduct basic laboratory procedures such as settleability tests for mixed liquor and suspended solids tests. For the remaining tests such sample need to be collected and prepared for shipment.

Plant Control and Monitoring

Plant control and monitoring requirements include space for operator workstations, desks for operator paper work, printers for PLC alarms and logs, shelving for reference material and typical office equipment including a standard printer, fax and copier.

Employee Facilities

Table 5.13-1 presents an estimate of staffing projections as the plant is expanded. The estimates are presented for planning purposes only and do not represent specific hiring decisions on the District's part.

Ultimately, the plant will be large enough to warrant complete locker room facilities with showers, restrooms, and a lunch break room. With an initial staff of only 3 to 4 employees, however, the cost of such facilities are difficult to justify. In the interim, it is recommended that a common work/break room be provided for meetings, breaks and lunches. A single shower will be provided in a private room for anybody who would need to shower while at the plant. Normally, however, employees would not shower at the site. A single uni-sex private toilet would be provided for employees and visitors.

As the plant capacity and staff expands, a dedicated employee facility will become warranted. This facility would include restrooms, locker rooms, showers, and combination lunch room-training room. The locker facilities should also be provided with direct entrance from the outside with a covered boot-wash area provided just outside the entrance. Also, a group sink should be provided to reduce the time operators must spend hand washing prior to breaks, lunch and quitting time.

Table 5.13-1
Plant Staffing Projections

Plant Capacity	Plant Staff	Max Number of Men[1]	Max Number of Women[1]
1 mgd (Phase 1)	3	3	2
4 mgd (Phase 3)	6-7	6	3
6 mgd (ultimate)	10	10	4

1 – Maximum number of men plus maximum number of women does not add to maximum plant staff since the maximum figure allows for ranges of male/female ratios

Office Requirements

A minimum of office space will be required at the plant, since it is assumed that administrative functions will occur at the district's main offices where equipment such as fax machines, copiers and printers are readily available. At the plant, space will be required for an operator desk, books shelves and a minimum of office equipment.

Maintenance Requirements

For the small staff size of the original plant, only minor maintenance tasks will be performed on site. To accommodate the maintenance which will be performed, a maintenance storage room will be provided, along with an covered, outdoor space adjacent to the operations building.

DESIGN DESCRIPTION

The proposed configuration of the Operations Building is included in Volume 2. **Table 5.13-2** summarizes the rooms and associated space provided.

Table 5.13-2
Operations Building Room Areas

Room	Available Area (ft^2)
Control Room	250
Sample Prep Area (Operator's Lab)	240
Shop	190
Electrical Room	130
Storage	20
Shower Room	100
Toilet	80
Mechanical Room	30
Hallway	170
Total Available Space	**1,210**

The building exterior walls will be constructed of slumpstone reinforced concrete masonry, furred on the interior with metal studs to receive fiberglass batt insulation. Windows and main entry doors will be extruded aluminum window wall system with tinted insulating glass units.

The gable roof will be framed with structural steel, open web joists and steel decking, insulated with rigid insulation board. The finish roofing material will be 2-piece tile.

Technical Memorandum No. 5.14
Power Supply and SCADA

CLIENT: Hi-Desert Water District

PROJECT: Water Reclamation Facility

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This technical memorandum addresses the electrical supply, motor control center (MCC), and standby power requirements and describes the basic structure and capabilities of the plant SCADA system.

POWER SUPPLY PERFORMANCE REQUIREMENTS

Power Demands

A listing of power demands, grouped by area within the plant, is shown in **Table 5.14-1**.

Table 5.14-1
Power Demands by Plant Area

Equipment	Load	Drive Type	Number on Standby Power
Headworks Area			
Mechanical Barscreen (2)	3 hp	starter	2
Washer/Compactors (2)	12 hp	starter	2
Grit Chamber Mechanism (1)	2 hp	starter	1
Grit Pumps (1+1)	5 hp	starter	1
Grit Cyclone Classifier (1)	1 hp	starter	1
Grit PS Sump Pumps (1+1)	2 hp	starter	1
Biofilter Fans (1+1)	15 hp	starter	1
Biological Reactors			
Anoxic Tank Mixers (4)	16 hp	starter	4
Oxidation Ditch Surface Aerator (2+2)	330 hp	VFD	2
Secondary Clarifiers			
Clarifier Collector Drive (2)	2 hp	starter	2
RAS Pumps (2+1)	40 hp	VFD	2
WAS Grinder (1)	3 hp	Starter	1
WAS Pumps (2)	30 hp	VFD	2
RAS/WAS PS Sump Pumps (1+1)	5 hp	starter	1
Filters			
Chemical Pumps (1+1)	5 hp	starter	1
Disinfection			
UV Lamp Banks (5)	41.0 kVA	circuit bkr	5

Equipment	Load	Drive Type	Number on Standby Power
Transmittance Analyzer Pumps (1+1)	0.5 hp	starter	1
Utility Water Pump Station			
UW Pumps (2+1)	30 hp	starter	2
Hypochlorite Feed Pumps (1+1)	1 hp	starter	1
Solids Handling			
Belt Filter Presses (2)	6 hp	starter	1
Polymer Blending Units (2)	1 hp	starter	1
Sludge Cake Conveyors (1)	10 hp	starter	1
Belt Wash Booster Pumps (2)	10 hp	starter	1
Miscellaneous			
Plant Drain Pumps (1+1)	10 hp	starter	1
Operations and Maintenance Bldg, Lighting, Controls, Power Tools	40 kVA	circuit bkr	1

Standby Power Provisions

To maintain basic treatment in the event of a power failure, standby power for the following equipment is recommended as a minimum:

- Bar screens and washer/compactors
- Biological reactor equipment and RAS pumps
- UV disinfection equipment
- Plant drain pumps
- Plant control systems

The following equipment would not require standby power to maintain treatment:

- Sludge dewatering equipment
- Odor control equipment
- Operations and Maintenance Buildings

Although the equipment listed above does not require standby power, it represents only a small fraction of the plant load. Provisions can be made to separate the loads so that standby power is only provided for essential loads. This can be accomplished by providing separate MCCs, or by providing control interlocks to turn off non-essential loads during power outages. Both solutions involve additional expense and complications that may or may not be offset by a reduction in the size of the standby generator.

For this facility, most of the normal power demand is essential and would have to be powered by the standby generator. Given the small difference in demand between the normal power demand and the demand during a shutdown, the expense and complications of separating essential and non-essential loads is not warranted.

Housing for Electrical Equipment

MCCs require either a weather-proof enclosure for outside installation, or NEMA 1 or NEMA 12 enclosures in a building. MCCs can also be supplied in a NEMA-3R walk-in enclosure supplied with the MCCs.

Variable frequency drives (VFDs) will be used for certain major loads, such as the Oxidation Ditch Aerators and RAS and WAS Pumps. VFDs typically are rated to operate at a maximum ambient temperature of 40ºC (104ºF) or 50º C (122 degrees F). Without air conditioning, however, the rooms in which they are installed can easily rise above these temperatures in the summer, which could cause failure of the key process equipment.

For these reasons, electrical rooms should be provided with air conditioning sufficient to remove the heat generated by the VFDs at the design peak temperature day.

Design Considerations

Provisions must be made in the design for the installation of future electrical equipment, and all associated conduit and wiring into and out of the electrical room. These provisions can include spare conduits and wiring trenches.

POWER SUPPLY PROCESS DEVELOPMENT

Location of Electrical Equipment

The design of electrical facilities must balance two contradictory ideals: providing motor control centers and controls close to the driven equipment, and consolidating electrical equipment into a single location to gain an economy of scale for housing the electrical equipment.

A power distribution facility will be constructed to receive power from the local utility and distribute it through the plant. The building will be located near the Biological Reactors which constitute the greatest load on site. The electrical equipment for the Biological Reactors will be housed near the power distribution facility. A walk-in MCC will be provided between the

RAS/WAS Pump Station and the UV facility to house electrical equipment for the remaining facilities. One MCC will be provided per 2-mgd treatment train constructed.

Sizing of Electrical Facilities

The power distribution facility should make provisions for the installation of electrical equipment for some future electrical loads. This could be accomplished by constructing an adjacent facility in the future, by expanding the initial facility, or by making the initial facility large enough to accommodate the future electrical loads. For this project, the proposed resolution is to make the initial facility large enough for the future electrical equipment.

POWER SUPPLY DESIGN DESCRIPTION

Electrical Power Distribution

A single new 480-volt, 3-phase, power feed will be provided to the site from the electrical utility, Southern California Edison (SCE). SCE will supply a step-down transformer. Power would be distributed to four MCCs initially, with two spare feeder breakers, and provisions for two additional power feeds for future construction. The electrical power distribution initial capacity will be sized for a plant capacity up to 2.0 mgd.

Standby Power Provisions

A diesel-engine generator will be provided for standby power. The standby generator will be located in a vendor-furnished sonic enclosure near of the power distribution facility. An above-ground, double-walled diesel-fuel storage tank will be provided. **Table 5.14-2** summarizes the sizing of the generator and fuel storage tank.

Table 5.14-2
Standby Generator Parameters

Parameter	Value
Standby Generator	
Type	Diesel-Engine
Capacity	1300 kW
Fuel Storage Tank	
Type	Above-ground, double-wall

The standby generator will start automatically on a loss of utility power. An electronically-interlocked tie-breaker would be provided to transfer the electrical supply from the utility feed to the standby generator when the power failed. The same tie-breaker would transfer the load back to the utility after the power failure ended.

A low level switch will be provided in the fuel storage tank to indicate when the fuel storage tank volume is low. The low level switch will be monitored by the SCADA system.

SCADA SYSTEM

Performance Requirements

The PCIS (Process Control and Instrumentation System) will be designed for a high level of automation, requiring minimal operator intervention under normal conditions. The plant will be capable of running with no operators on-site during the non-business hours and on weekends, with remote monitoring and operations from the District Headquarters.

Redundancy

Modern Programmable Logic Controllers (PLCs) are highly reliable, with Mean Times Between Failure (MTBF) of more than 30 years. In this application, redundant PLC processors are not required. Systems will be designed with emergency manual backup controls.

Communications

The PLC-based control system will be configured to allow communication with remote locations. A wireless local area network will provide communications to portable HMI (Human-Machine Interface) workstations throughout the plant.

Control System Overview

Objective

The objective of the control system is to provide the ability to efficiently and safely control and monitor the treatment plant both locally, and remotely. This includes the following:

Local control objectives:

- Start up equipment and facilities.
- Shut down the equipment and facilities.
- Respond to alarms.
- Make control adjustments.
- Monitor the process.
- Perform automated control sequences.

Remote control objectives:

- All of the above, except for start-up.

Operations MIS Software Integration

The SCADA system will provide performance monitoring data, such as accumulated equipment run-times, to an asset management system. The data interface and data access protocols will be defined during the design phase.

Control Hierarchy

The control system will provide the following basic hierarchy of control from the field device to the control room:

- Local manual control mode of individual devices and sub-systems. This mode is executed from the local control stations or local control panels that are located in close proximity to the equipment. These controls have the highest priority. For example, if a Hand-Off-Auto (HOA) switch at a local device is in the Hand position, remote SCADA control will not be possible. However, device status and the HOA switch position are monitored by the SCADA system.

- Remote manual control mode of individual devices and sub-systems through the SCADA. This mode will mainly be used for periodic maintenance, testing, and short-term operation and will be available through any of the HMI operator workstations.

- Remote automatic control mode, based on operator-entered setpoints.

Control System Architecture and Hardware

The following are the key hardware components of the Plant's control system with a functional description of each of the components:

Programmable Logic Controllers (PLCs)

PLCs will be specified to include programming software, spare PLC hardware components, and operator training. A simplified sample SCADA system diagram is shown in **Figure 5.14-1**.

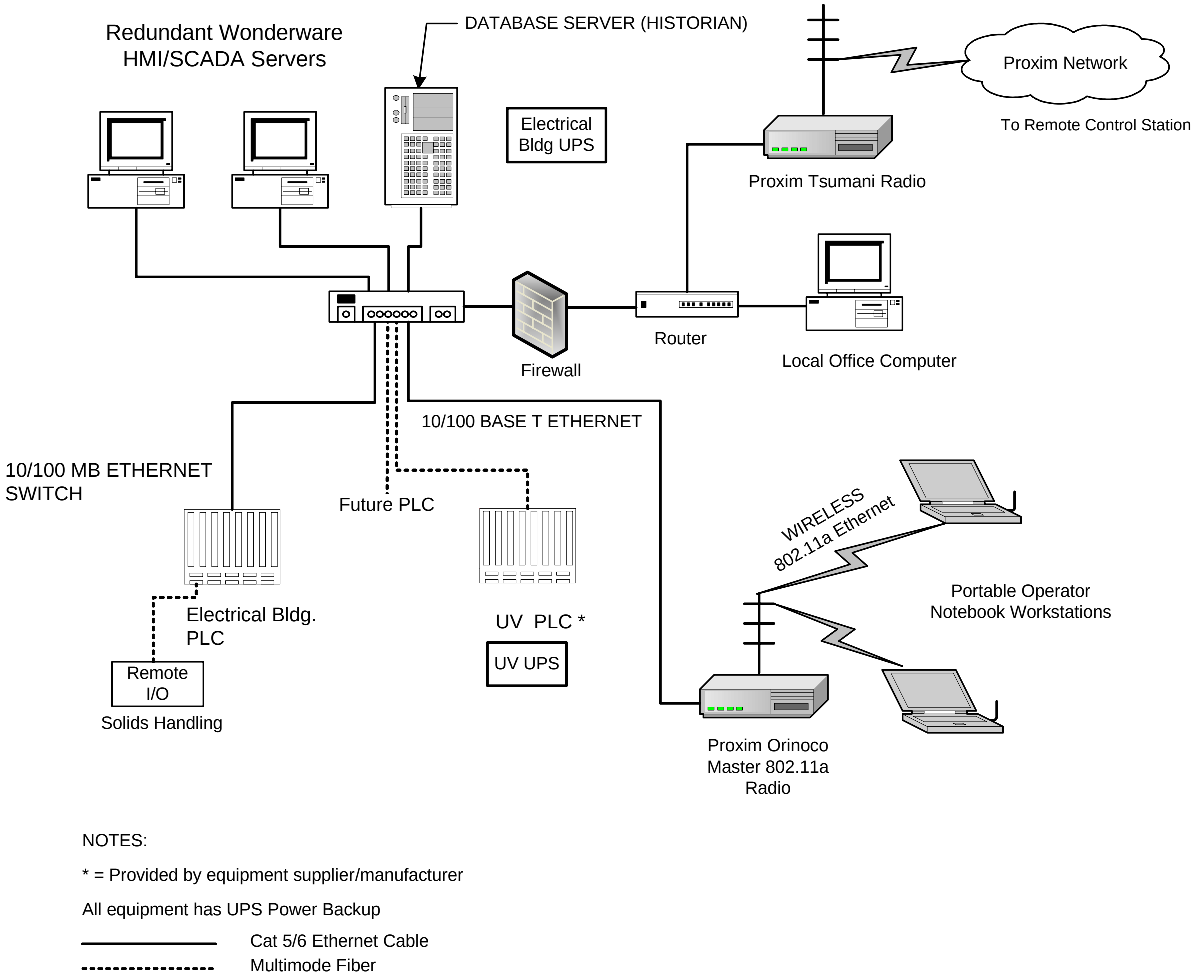

Figure 5.14-1
Sample SCADA System Diagram

Programmable Logic Controllers (PLCs)

The Plant will be controlled by a distributed network of PLCs. The PLCs will be programmed to provide automatic sequencing and control of the equipment, monitor status, and initiate alarms. The PLC network will be independent of the HMI. Should the HMI be unavailable, or unattended, the PLCs will continue to operate on the basis of the last entered setpoints.

HMI Operator Interface

The HMI (Human-Machine Interface) is the operator interface that provides a graphical interface between the operator and the equipment. The HMI also provides alarm logging, trending, and historical database logging. The HMI application program will run on redundant HMI computers (workstations).

The workstations will be located in the Operations Building. To ensure security and reliability, the HMI workstations will not be used as general-purpose PCs, will have no connection to the Internet, and will not have general-purpose office software such as Microsoft Office. These functions will be provided by a separate office computer connected to the SCADA local area network (LAN) through a router and firewall.

HMI client software will also be used on the operators' notebook computers to provide remote wireless HMI access in all areas of the plant. Fold-down shelves with sunshades and power receptacles can also be provided for operators to place their portable computers.

Intra-Plant SCADA Communications

Communications between fixed SCADA nodes, including the HMI workstations and the PLCs, will use Ethernet and will be CAT5/6 cable within a building, and multimode fiber optic cable between locations. The fiber optic cable will provide immunity to the high electrical noise environment inherent in a wastewater treatment plant, and expansion for future capabilities such as CCTV security monitoring.

An 802.11a wireless local area network will provide communications to portable HMI workstations, using notebook computers, throughout the plant. Wireless communications will use encrypted communications up to 54 mbps with Wi-Fi Protected Access (WPA) security. The 802.11a technology is recommended because it operates in the 5 GHz region and is not subject to interference from wireless phones, microwave ovens or Bluetooth devices. A Cardbus card such as Proxim's ORiNOCO ComboCard will be used in operator's notebook computers.

Uninterruptible Power Supplies (UPS).

UPS systems will be provided in the main electrical building, and at the remote PLC panel in the UV facility to ensure that all key instrumentation, control, and communications hardware remain functional during a utility power outage for a minimum of two hours. All UPS units will be of the true double-conversion type to provide power noise protection. UPS status will be monitored from the SCADA system.

Section 6
Site Development

The Technical Memoranda in Section 5 describe the various process units and support facilities. This section describes how those facilities are configured on the site and they fit into the hydraulic profile.

SITE PLAN DEVELOPMENT

Key issues for development of the site plan include issues with the existing property, drainage and flood control issues, development of the site and how expansions will be staged, and the need for further investigations.

Property Issues

For the treatment plant, the District has purchased two parcels located on the south side of Highway 62 just east of the right-of-way for Indio Avenue and extending south to Sunnyslope Drive. (Indio Avenue is not currently constructed between Sunnyslope and the Highway.) Drawing 00-1 shows the property limits of the two parcels.

Because the northern portion of the property has highway frontage, it could potentially be sold off to a commercial developer at a high price. If that portion were to be sold off, the most reasonable place to divide the parcel would be at the extension of the Palisade Road right-of-way, which does not currently extend east of Indio Avenue. The extension of Palisade Road is also shown in Drawing 00-1. It should be noted that there is no requirement to divide the property, and it could be divided at a different location.

Drainage and Flood Control

A wash passes diagonally through the property. According to the County Flood Control Master Plan, this wash has a 100-year flood flow rate of 11,000 cubic feet per second. Because the wash is not confined, the flood limits are not readily apparent, and no flood calculations have been performed to determine the extent of the flood area. A conservative assumption was made on the limits of the flood plain, as shown in Drawings 00-1. These limits could be defined more precisely by conducting a flood study, which is outside the scope of this report.

Site improvements could also be made that would confine the flood area to a much smaller area of the site. Such improvements would have to be coordinated with the County to avoid increasing the downstream flood potential. Downstream flood potential is a significant concern because there is currently no provision for the wash to pass under Highway 62, which currently floods during storms.

Site Plan and Staging

The proposed site plan is shown in Drawing 00-2. This plan shows the treatment processes for 6 mgd, but only two percolation ponds. The two ponds shown on the site plan represent approximately 2 mgd of capacity, subject to verification of percolation rates by on-going field tests. The treatment and support facilities are constructed from the south east corner to the north and to the west. The liquid treatment process will be constructed in three sets of 2-mgd treatment trains. Support facilities including the operations building, headworks, and sludge dewatering building will not require further expansion in the future.

Issues for Further Investigations

A flood study should be conducted to determine the extent of the site in the flood plain, and to identify measures to limit the flood area.

Percolation testing should continue to verify the total area required for the ultimate 6 mgd of effluent that will be generated. It will likely be necessary to construct additional percolation ponds either; 1) in the remaining area of the property outside of the potential flood plain, 2) in the areas that might be in the flood plain after measures have been taken to limit the flood area, or 3) on a different site location.

HYDRAULIC PROFILE

The influent sewer enters the plant at an elevation which can accommodate gravity feed into the headworks eliminating the need for an influent pump station. In addition, the plant site has a natural grade around around 2.5% which allows the plant hydraulic structures to be laid out such that no intermediate pump stations are required within the plant. Water will continue by gravity to percolation ponds located at the north end of the site.

The hydraulic profile calculations are based on the assumptions discussed in this section. The hydraulic profile is shown on Drawing 00-3 in Volume 2.

Flows and Peaking Factors

The hydraulic profile was generated to accommodate the ultimate buildout of the plant to 6 mgd with a peak hour factor of 3.0. With the absence of equalization facilities, the peak hour factor was considered constant through all plant hydraulic structures.

Recycle Flows

In addition to the peaking factors, the presence of internal recycle flows also affects the total flow rate which must be hydraulically accommodated. **Table 6-1** lists the assumptions made for the various internal recycle quantities.

Table 6-1
Recycle Quantity Assumptions

Recycle Stream	Assumed Quantity at Ultimate Capacity
Return Activated Sludge Flow	150% Average Plant Flow
Filter Back Wash	
per Filter Train	300 gpm (5 filter cells in service)
Total (Ultimate Flow)	900 gpm (3 trains)
Belt Filter Press Filtrate	500 gpm (2 BFPs)
Belt Filter Press Washwater & Miscellaneous (hose bibbs, dilution water, etc)	250 gpm (2 BFPs)

Section 7
Construction Costs

An opinion of probable construction cost (OPCC) for the Water Reclamation Plant was prepared based on the facilities described in Sections 5 and 6 of this report. The OPCC was prepared in accordance with a Class 4 cost estimate as defined by the Association for the Advancement of Cost Engineering. Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from –15% to –30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

A summary of the OPCC for the 2 mgd water reclamation facility is shown in **Table 7-1**. The numbers include a 20% project contingency. A more detailed itemization of costs is included in **Appendix-A**.

Table 7-1
Opinion of Probable Construction Cost for
2 Mgd Water Reclamation Facility

Area	Description	Project Cost (2008$)
	Site Development	4,930,000
1	Influent Pumping	1,410,000
2	Headworks	2,570,000
3	Bioreactors	9,310,000
4	Clarifiers	3,090,000
5	RAS Pump Station	880,000
6	Filters	2,510,000
7	UV Disinfection	2,250,000
8	Utility Water Pump Station	480,000
9	Percolation Ponds	550,000
10	Sludge Dewatering	3,750,000
11	Plant Drain Pump Station	350,000
12	Odor Control	480,000
13	Operations Building	1,180,000
14	Power Supply & SCADA	3,220,000
	Total	**$36,960,000**

Section 8
Project Implementation

The District intends to implement the Water Reclamation Facility using an alternative project delivery approach such as design-build, design-build at risk or construction manage at risk. These and similar approaches to procurement provide opportunities to re-examine the technologies, equipment, configuration, and layout of the proposed treatment processes. Alternative delivery methods do need to be conducted within defined constraints so that basic functionality, reliability and other needs of the District will be provided regardless of the treatment facilities that are proposed. This section describes recommended general constraints related to the facilities for alternative delivery. More detailed constraints related to contractual, design and engineering, equipment and materials, layout and other aspects of implementation will need to be developed and refined but are not addressed here..

UNIT PROCESS PERFORMANCE CONSTRAINTS

The following sections list key elements, by process area, for consideration during solicitation of design-build teams and review of design submittals.

Influent Screening and Grit Removal

For all treatment processes, screening should be provided to remove solids larger than 3/8-inches in the smallest dimensions. If an MBR process is selected, additional screening will be needed with requirements determined by the membrane manufacturers.

Grit removal should be provided at the headworks to prevent accumulation in the downstream unit process. Grit removal may be omitted or postponed only if the downstream unit process has a spare tank in parallel such that one tank can be taken out of service for manual grit removal without impacting the plant capacity.

Flow Equalization

Flow equalization is not required, but it can be used to reduce the required size of downstream processes by reducing peak flow rates. Flow equalization can also improve process efficiency. Any proposed systems with flow equalization should satisfy the following criteria:

- Sufficient equalization volume is provided to limit the peaking factor under the full range of design flow conditions. Equalization facilities should be multiple or segmented, dedicated tanks or basins.
- Equalization basins storing wastewater upstream of biological treatment should be covered and provided with odor control.
- An automated wash down system should be provided to prevent the accumulation of solids on the sides and bottom of the equalization basin. Wash down systems for

equalization facilities upstream of biological treatment require higher rates and volumes of wash water than cleaner applications, such as secondary effluent equalization.

- Cost evaluations should include the cost of additional pumping and the maintenance costs associated with the pumping facilities.

Biological Treatment

Any biological treatment process proposed for this project should be capable of reliably meeting the anticipated treated effluent standards under the assumed influent loading conditions described in Section 2. In addition, preference should be given to processes that:

- Can be modified in the future to achieve lower effluent nitrogen levels;
- Achieve better removal of contaminants of emerging concern such as personal care products, pharmaceuticals, and other trace organic compounds.
- Produce a stabilized sludge that is not likely to generate strong odors after dewatering and while stored on-site for short durations of 24 hours;
- Are proven, demonstrated and reliable in similar full-scale applications; and
- Can be operated by the existing southern California wastewater operator workforce with minimal additional training.

Effluent Filtration and Disinfection

Any effluent filtration and disinfection processes must be demonstrated and approved or accepted by the California Department of Public Health (CDPH) for the intended application. This applies to alternative process configurations that replace the function of filtration, such as MBRs.

Disinfection should be achieved by UV irradiation using a system that is CDPH-approved or accepted under the prevailing guidelines and approval process. A guarantee that the final installed system will meet all CDPH requirements should be provided to the District with the proposal and bid submission.

Solids Dewatering

Alternative solids dewatering processes and equipment may be considered. The evaluation of alternative dewatering processes should include the full life-cycle costs of each alternative, including labor, power, chemicals, sludge disposal, maintenance, and replacement. Other considerations should include the potential for odor release and vector attraction, reliability, and sensitivity to changes in power costs and disposal costs. Open-air drying of sludge should not be considered.

SITE DEVELOPMENT CONSTRAINTS

Any alternative site arrangements should satisfy the following criteria:

- The layout should accommodate a facility with an ultimate capacity of at average flow of at least 6 mgd.
- The ultimate facilities should fit within the southern portion of the site (south of the Palisade Road extension) and outside of the 100-year flood plain.
- The layout should include space within the southern portion of the site for at least 2 mgd of percolation pond capacity, with one pond out of service for cleaning.
- Constraints for access, underground utility routing, grading, drainage, landscaping and security.

For each of these, more detailed criteria will be needed including regulatory constraints, mitigation measures resulting from the CEQA process, etc.

Appendix-A

Class 4 Opinion of Probable Construction Cost

HI-DESERT WATER DISTRICT
WATER RECLAMATION FACILITY
PRELIMINARY DESIGN
OPINION OF PROBABLE CONSTRUCTION COST BY PHASE

Area Num	Description	*Raw Cost*	2 Mgd Project Cost	Fractions of 2 Mgd Cost		Project Costs by Phase (2010$)	
				Phase 1	Phase 2	Phase 1	Phase 2
	Site Development	*4,106,564*	4,930,000	100%	0%	5,230,000	0
1	Influent Pumping	*1,172,921*	1,410,000	90%	10%	1,340,000	150,000
2	Headworks	*2,138,209*	2,570,000	100%	0%	2,720,000	0
3	Bioreactors	*7,755,523*	9,310,000	60%	40%	5,920,000	3,950,000
4	Clarifiers	*2,578,897*	3,090,000	100%	0%	3,280,000	0
5	RAS Pump Station	*734,188*	880,000	90%	10%	840,000	90,000
6	Filters	*2,091,884*	2,510,000	80%	20%	2,130,000	530,000
7	UV Disinfection	*1,875,289*	2,250,000	100%	0%	2,390,000	0
8	Utility Water Pump Station	*396,765*	480,000	100%	0%	510,000	0
9	Percolation Ponds	*454,753*	550,000	100%	0%	580,000	0
10	Sludge Dewatering	*3,124,342*	3,750,000	100%	0%	3,980,000	0
11	Plant Drain Pump Station	*290,527*	350,000	100%	0%	370,000	0
12	Odor Control	*396,066*	480,000	100%	0%	500,000	0
13	Operations Building	*985,842*	1,180,000	100%	0%	1,260,000	0
14	Power Supply & SCADA	*2,685,124*	3,220,000	100%	0%	3,420,000	0
	Total	***30,786,894***	**36,960,000**	**93%**	**13%**	**34,470,000**	**4,720,000**

20% Project Contingency
3% Inflation Rate
2 Years to Reference
4 digit rounding

*Value includes a 20% project contingency

OPCC MODEL OVERVIEW

MWH CONSTRUCTORS

Project Name	**Hi-Desert Water District WRF**	*Scope Receipt Date*	**22-Sep-08**	*OPCC Total*	**$30,786,893**
Project City & State	**Yucca Valley, CA**	*OPCC Complete Date*	**29-Sep-08**	*OPCC Class*	**Class 4 (per AACE, Int.)**
Project Contact	**Jeff Mohr**	*OPCC Prepared By*	**Jim Ward**	*MWHC Project #*	**7012451**
Contact Phone #	**(626) 568-6299**	*OPCC Version*	**001**	*MWHC Account #*	**11029000**

Model Philosophy & Methodology

This OPCC model is based upon establishing bare construction costs through development and application of three (3) major installation elements, which are MH (labor manhours), M&E (consumables/materials and installation equipment/tools), and EQ (buy-out/engineered equipment). These costs are then subsequently adjusted per the applicable line items defined below.

In order to accomplish the above, the model utilizes a combination of parametrics, factoring (capacity and/or equipment), and unit-cost methods (by size, end-product use, dimension, and/or ratio), in order to establish a class 3-5 OPCC in accordance with guidelines presented in AACE, International recommended practice publication 18R-97.

Contractor-Level Adjustments

Name	Purpose
Payroll Deducts & Workers Comp Rate	Allowance for payroll insurances & taxes (i.e. un-employment, social security, state/federal withholding, etc.) and state workers compensation insurance
Small Tools & Equipment Rate	Allowance for replacing small "consumable" items (i.e. hand tools, hand-held power tools, personal safety gear, etc.)
Tax/Burden Application Scope	Category of buy-out/engineered equipment and/or construction costs to which some type of mandated burden (i.e. sales tax, VAT, import tariff, liquidated damages, royalty, commission, etc.) will be applied
Tax/Burden Rate	Allowance for the mandated burden on the categories of buy-out/engineered equipment and/or construction costs selected above
Insurance Rate: Builders Risk	Allowance for insuring the project capital & construction costs
Insurance Rate: General Liability	Allowance for insuring for the project liability issues
Insurance Rate: Pay & Perform Bonds	Allowance for insuring the payments to suppliers, vendors, & subcontractors, as well as insuring the project contract value with respect to satisfactory completion for the Owner
Overhead & General Conditions Rate	Allowance for the project field overheads (both direct & indirect), a portion of the home office overheads (indirects only), and the anticipated field general requirements (i.e. mobilization, temporary utilities, temporary facilities, temporary construction, temporary controls, construction aids, preparations, examinations, cleaning, waste management, accessibility, parking, barriers, enclosures, storage, handling, signage, photos, permits, inspections, reviews, protection, security, submittals, approvals, close-out, start-up preparation, adjustments, punch-out, and demobilization)
Profit Rate	Allowance for project profit before taxes

Estimator-Level Adjustments

Name	Purpose
Project Type & Installation Delivery	Definition of the overall type of project and how the construction will be executed, which subsequently establishes the rates for the contractor adjustments identified above. ***NOTE: Although installation delivery through a CM may appear higher in cost then through a GC, the GC alternative is not able to reflect the Owner's additional expenses for management, oversight, administration, QA/QC, start-up, and any third-party participation.***
Freight Application Scope	Category of buy-out/engineered equipment and/or construction materials to which packing & shipping costs will be applied
Freight Rate	Allowance for packing & shipping of the categories of buy-out/engineered equipment and/or construction materials selected above
Equipment Spare Parts Scope	Allowance for supplying the "critical" spare parts for the buy-out/engineered equipment over the duration indicated
Escalation APR: Installation MH	Allowance for the yearly installation labor cost increase anticipated to occur
Escalation APR: Installation M&E	Allowance for the yearly installation materials, consumables, and equipment/tools cost increases anticipated to occur
Escalation APR: Project EQ	Allowance for the yearly buy-out equipment cost increase anticipated to occur
Years of Escalation Applied	Duration or "life" of this OPCC, over which the escalation rates described above have been applied, which has been anticipated as the time required for Customer negotiation, contract award, project design, Contractor solicitation, award/mobilization, and up to the mid-point of construction
Estimator Contingency Rate	Allowance for the potential Estimator take-off and/or cost "misses" if actually constructing the project from the current design documents provided. ***NOTE: Design/project contingency must be added by others.***
Local Market Premium Rate	Allowance for the escalation anticipated to occur for local bid and/or market conditions, labor availability, and/or project execution issues

MWH CONSTRUCTORS

CLARIFICATIONS - Class 4 OPCC

Project Name	Location	Estimator	Date	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	Jim Ward	29-Sep-08	001	7012451

	Clarifications & Exceptions
1	This OPCC has been based upon the Preliminary Design Report submittal comprised of the volume 1 report (110 pages) and volume 2 Drawings (21 sheets) all dated 15Sep08 and received 19Sep08.
2	Where discrepancies and/or conflicts arise between the various documents provided for this OPCC, the worst-case (i.e. typically highest cost) scenario has been anticipated in developing the OPCC unless advised otherwise.
3	This OPCC has been assigned a Class 4 (i.e. screening/feasibility level) status, in accordance with our judgment on the level of project definition, expected accuracy range, and other characteristics as described in AACE International Recommended Practice # 18R-97.
4	The expected accuracy range variations of this Class 4 OPCC are as follows: Low = (-)15% to (-)30% and High = (+)20% to (+)50%, with a 90% confidence that the actual cost will fall within the bounds of these ranges after application of the appropriate contingencies.
5	***With this class of OPCC, the addition by others of a 20% scope/design contingency is strongly recommended, with the intent of providing coverage for the potential project and/or design requirement oversights, omissions, mis-interpretations, and undefined regulatory considerations.***
6	This OPCC represents the execution of a Bid/Build project by the Owner utilizing a General Contractor with oversight and commissioning responsibility who self-performs ~50% of the installation work and contracts the remaining balance to individual specialty Subcontractors.
7	Construction management services by MWHC for this project have not been included at this time.
8	In addition to the clarifications below, almost every worksheet should be referenced for supplemental information under the " *Scope Clarifications* " section appearing at the top, where drop-downs further identify the work scope, materials, and site/working conditions that will apply to the line-items actually nputted.
9	As an OPCC is only a "snapshot in time" based on applicable professional industry practices, subsequent and unpredictable events which could impact market prices (i.e. hurricanes, floods, earthquakes, spot shortages, inflation, etc.) can have a substantial impact on the OPCC.
10	All non-construction costs to execute this project shall be provided by others, including but not limited to property acquisition, easements, ROW's, financing, leasing, legal, field services, lab services, engineering, project management, insurances, OH&P, and all related T&L, taxes, and fees.
11	The site soil conditions are anticipated to be suitable for the OPCC scope, with all excavation & trenching to utilize typical profiles and side cuts, and requiring no consideration for hard excavation, shoring < 15', deep foundations, obstructions, excessive groundwater, hazardous materials, and remediation.
12	The site has been anticipated to be capable of providing the required power (both in current & voltage), with all transformers, equipment, and gear greater then 480 VAC being supplied and installed by others.
13	All buy-out/engineered equipment costs have been derived from the MWHC equipment database, either by selection or extrapolation of similar items, and all special packaged/skidded items are anticipated to be pre-piped and pre-wired by the Vendor to the maximum extent possible.
14	All costs for current and/or future repairs, modifications, demolition, coatings, O&M, restoration, code upgrades, and LEED considerations shall be provided by others unless indicated otherwise in any of the DIV worksheets.
15	Disposal and/or salvage facilities have been anticipated to be available within a maximum 15 mile radius from the work site. Salvage values however have not been included.
16	For the un-symmetrical and/or highly complex concrete structures and components, dimensional "averaging" and/or complexity "smoothing" has been utilized in order to establish units that comply with the OPCC templates while still maintaining the wall/slab sizing and aspect ratios.
17	The electrical generator for Paxton PS has been sized for the full phase III capacity requirements, currently anticipated to be ~500 kW @ 480 VAC.
18	A bridge hoist system and perimeter privacy fence/gate has been provided for the operations building outdoor work area.
19	The "Site Development" area # 15 has been added to the *"Special Summary"* sheet and includes asphalt paving, site fencing, site bollards/guardposts, site lighting units, and general site allowances for excavation, concrete, piping, and electrical. See the individual DIV sheets for details.
20	A single slab structure, 75' x 20', has been anticipated on which the generator, diesel storage tank, and walk-in MCC units will be installed.
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MWH CONSTRUCTORS

SPECIAL SUMMARY - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of the Project OPCC

Adjustment Allowances

Project Type & Installation Delivery	B/B: GC + 50% Subs	*Equipment Spare Parts Scope*	1 Year Supply
Payroll Deducts & Workers Comp Rate	34.0%	*Freight Application Scope*	EQ
Small Tools & Equipment Rate	5.0%	*Freight Rate*	2.9%
Tax/Other Application Scope	EQ + Install M&E	*Escalation APR: Install MH*	3.0%
Tax/Other Rate	7.25%	*Escalation APR: Install M&E*	10.0%
Insurance Rate: Builders Risk	1.7%	*Escalation APR: Project EQ*	2.0%
Insurance Rate: General Liability	1.5%	*Years of Escalation Anticipated*	1.25
Insurance Rate: Pay & Perform Bonds	2.0%	*Estimator Contingency Rate*	12.5%
Overhead & General Conditions Rate	13.0%	*Local Market Premium Rate*	0.0%
Profit/Fee Rate	5.0%	*Total Construction Duration*	77 weeks

OPCC Bare & Adjusted Cost Summary

		Bare Data					*Adjusted Data*				
#	Description or Area Name	Install MH	Install MH $	Install M&E	Buy-Out EQ	BARE TOTAL	Install MH	Install MH $	Install M&E	Buy-Out EQ	ADJUSTED TOTAL
1	**Influent Pumping**	4,387	$211,933	$249,347	$268,027	**$729,307**	4,935	$382,953	$409,630	$380,338	**$1,172,921**
2	**Headworks**	8,107	$406,579	$334,680	$601,626	**$1,342,885**	9,121	$734,669	$549,816	$853,723	**$2,138,209**
3	**Bioreactors**	47,618	$2,394,570	$1,500,063	$679,570	**$4,574,203**	53,570	$4,326,875	$2,464,319	$964,328	**$7,755,523**
4	**Clarifiers**	13,352	$667,490	$553,649	$326,445	**$1,547,583**	15,021	$1,206,123	$909,540	$463,234	**$2,578,897**
5	**RAS Pump Station**	3,164	$157,303	$156,064	$136,406	**$449,774**	3,559	$284,239	$256,384	$193,564	**$734,188**
6	**Filters**	9,656	$492,883	$309,030	$488,778	**$1,290,691**	10,863	$890,616	$507,678	$693,589	**$2,091,884**
7	**UV Disinfection**	2,950	$148,857	$164,571	$941,456	**$1,254,884**	3,318	$268,978	$270,359	$1,335,952	**$1,875,289**
8	**Utility Water Pump Station**	1,906	$95,516	$73,290	$73,128	**$241,934**	2,144	$172,593	$120,402	$103,770	**$396,765**
9	**Percolation Ponds**	2,005	$83,864	$184,570		**$268,434**	2,255	$151,538	$303,214		**$454,753**
10	**Sludge Dewatering**	8,940	$442,668	$562,967	$986,319	**$1,991,954**	10,057	$799,880	$924,848	$1,399,615	**$3,124,342**
11	**Plant Drain Pump Station**	1,655	$81,823	$63,032	$27,574	**$172,428**	1,862	$147,850	$103,550	$39,128	**$290,527**
12	**Odor Control**	1,879	$95,552	$90,902	$52,200	**$238,654**	2,114	$172,657	$149,335	$74,073	**$396,066**
13	**Operations Building**	4,244	$206,631	$294,877	$90,233	**$591,741**	4,775	$373,372	$484,428	$128,043	**$985,842**
14	**Power Supply & SCADA**	3,373	$160,153	$236,685	$1,414,283	**$1,811,121**	3,795	$289,388	$388,829	$2,006,907	**$2,685,124**
15	**Site Development (JSW)**	26,420	$1,169,124	$1,169,783	$50,936	**$2,389,843**	29,722	$2,112,552	$1,921,732	$72,280	**$4,106,564**
	OPCC Total	139,655	$6,814,944	$5,943,512	$6,136,981	**$18,895,437**	157,112	$12,314,283	$9,764,064	$8,708,546	**$30,786,893**

Contruction Management Summary

Scope Description	Percent of OPCC total	TOTAL
Construction Management Staffing & General Contracting		
Construction QA & QC		
Start-up & Commissioning		
Subtotal		
Construction Management Fee		
Subtotal		
P&P Bonds and Insurances (General Liability + Builders Risk)		
OPCC & Construction Management Total		

MWH CONSTRUCTORS

INSTALLATION OVERVIEW - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIVS 1-16

Scope Clarifications

Installation: Standards	Municipal or Governmental	*Work Area: Scope Complexity*	Rehab/Replace & Expand Existing
Labor: Classification	Local Union/Collective Bargain Unit	*Work Area: Scope Density*	50% of Equipment Spread Out
Labor: Work Hours	Straight Time: 8 hr days M-F	*Piping Max Flow Range*	1,330-1,800 gpm (16"Ø gravity)
Labor: Work Efficiency	90% (7.2 hrs of actual work/shift)	*Piping/Raceways: Complexity*	Short Runs & Basic Manifolding
Labor: Work Shifts	1st Only (OT optional)	*Piping/Raceways: Supports*	Strut System-Galvanized CS
Labor: Shift Differential		*Special: High/Elevated Work*	
Site: Seismic Zone	Zone 3 (US)	*Special: Clean Room Work*	
Site: Frost Depth Range	5"-10"	*Special: Hazardous Work*	
Site: Wind Speed Range	Basic: 0-70 mph	*Special: Hot/Cold Work*	40% performed @ > 95° F
Site: Accessibility Issue		*Special: Rain/Snow Work*	10% performed in Rain/Snow
(un-assigned)		*Special: Night Work*	
(un-assigned)		*Special: DBE Work*	20% DBE Participation

Means City Index Localizing Factors

Means City & State Riverside, CA (July 2008)

	DIVS 1-2 GC's-Sitework	DIV 3 Concrete	DIV 4 Masonry	DIV 5 Metals	DIV 9 Coatings	DIV 13 Special	DIV 15 Mechanical	DIV 16 Electrical
Materials	109	121	92	130	113	116	111	96
Labor	108	130	118	108	131	120	125	102

Non-Union Labor Option

☐ DIV 1-GC's ☐ DIV 2-Sitework ☐ DIV 3-Concrete ☐ DIV 4-Masonry ☐ DIV 5-Metals

☐ DIV 9-Coatings ☐ DIV 13-Special (bldgs) ☐ DIV 13-Special (tanks) ☐ DIV 15-Mechanical ☐ DIV 16-Electrical

DIVS 1-17 Worksheet Bare CSI Roll-Up

DIV #	Description	SF	CY	Tons	MH	MH Rate	MH $	M&E	BARE TOTAL
DIV 1	*General Conditions (established by % in Summary sheet)*								
DIV 2	*Sitework Construction*				19,442	$39.30	$764,083	$1,010,656	**$1,774,739**
DIV 3	*Concrete Construction*		8,221		80,346	$50.56	$4,062,089	$2,175,176	**$6,237,266**
DIV 4	*Masonry Construction NIS*								
DIV 5	*Metals Installation*				2,481	$48.01	$119,089	$96,748	**$215,836**
DIV 5	*BUYOUT: Metals Assemblies*			53.1					**$745,698**
DIV 9	*Coating Installation*	15,511			2,610	$44.23	$115,436	$237,767	**$353,203**
DIVS 11-15	*BUYOUT: Process & Mechanical Equipment*								**$3,665,550**
DIV 13	*Special Construction*				8,992	$48.20	$433,431	$639,928	**$1,073,359**
DIV 15	*Equipment & Piping Installation*				12,352	$56.93	$703,227	$848,573	**$1,551,800**
DIV 16	*Power and I&C Installation*				13,432	$45.98	$617,589	$934,664	**$1,552,252**
DIV 16	*BUYOUT: Power Distribution & Controls*								**$950,993**
DIV 17	*BUYOUT: Instrumentation & Process Controls*								**$774,740**

DIVS 1-17 Worksheet Bare Total

	Anticipated Construction Duration		MH	Avg MH Rate	MH $	M&E Cost	BARE TOTAL
DIVS 1-17 Totals	77 weeks		139,655	$48.80	$6,814,944	$5,943,512	**$18,895,437**

MWH CONSTRUCTORS

DIV 2 (Sitework) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIV 2

Scope Clarifications

Survey & Soil Test Scope		*Temporary: Wood Supports*	Shoring w/ Walers & Struts
Site Clearing Scope		*Deep Foundation Scope*	
Rough Grading Scope		*Deep Foundation Services*	
Soil Excavation Issues		*Asphalt Pavement Scope*	Heavy-Duty & Asphalt Curbing
Structure Excavate Scope	Excavate with Partial BF	*Soil Liner Scope*	
Structure Base/Fill Material	Stone ¾"-1½" (imported)	*Other Base/Overlay Material*	
Trench Scope		*Stormwater Control Scope*	
Trench Bed/Fill Material		*Fencing Scope*	GS Chain Link w/ Slats & Wire
Fine Grading Scope		*Landscaping Scope*	
Temporary: Dewatering		*Site Installation Allowances*	Low Density
Temporary: Erosion Control		*(un-assigned)*	

DIV 2 Sitework Scope

Site Grading & Excavation

#	Name or Location	Qty	Type	Long	Wide-Ø	Deep	Cut °	CY/Thk	Tons	MH	MH @ $39	M&E	BARE TOTAL
	Survey & Soil Test NR	0	0.0	0	0								
	(site clearing ID)	0	0.0	0	0								
	Spoil Haul-Away NR	0%											
	(rough grade/contour ID)	0	0.0	0	0	0	0						
	Fill NR	0%	0.0	0.0									
1	Paxton MH & PS excavate	1	1.30	37.0	17.5	20.0	90	480	615	92	$3,601	$1,624	$5,225
1	Base/Fill	5%	1.2	1.0				24	32	4	$176	$482	$658
1	Paxton PS bldg excavate	1	1.30	50.0	15.0	2.0	45	65	84	13	$530	$227	$757
1	Base/Fill	50%	1.2	1.0				33	44	6	$254	$658	$912
12	Paxton PS biofilter excavate	1	1.30	41.0	17.0	3.0	45	97	125	20	$786	$337	$1,123
12	Base/Fill	33%	1.2	1.0				32	43	6	$248	$646	$894
1	Paxton PS road excavate/fill	1	1.30	300.0	8.0	1.0	45	100	129	21	$807	$347	$1,154
1	Base/Fill	100%	1.2	1.0				100	136	20	$774	$2,018	$2,792
2	HW structure area excavate	1	1.30	81.5	81.5	8.0	45	2,359	3,026	291	$11,439	$7,174	$18,613
2	Base/Fill	12%	1.2	1.0				283	382	39	$1,533	$5,691	$7,224
3	Ditch area excavate	1	1.30	210.0	210.0	10.0	45	17,896	22,952	507	$19,918	$45,716	$65,634
3	Base/Fill	10%	1.2	1.0				1,790	2,416	124	$4,892	$35,977	$40,869
4	Clarifier/scum area excavate	2	1.30	0.0	80.0	12.0	45	5,909	7,578	602	$23,676	$17,320	$40,996
4	Base/Fill	8%	1.2	1.0				473	638	58	$2,274	$9,503	$11,777
4	ML splitter box excavate	1	1.30	20.0	14.0	5.0	45	85	109	17	$687	$295	$982
4	Base/Fill	20%	1.2	1.0				17	23	3	$132	$342	$474
5	RAS/WAS area excavate	1	1.30	54.0	34.0	13.0	45	1,447	1,856	226	$8,885	$4,644	$13,529
5	Base/Fill	7%	1.2	1.0				101	137	16	$643	$2,037	$2,679
6	Flash mix tank excavate	1	1.30	20.0	20.0	6.0	45	145	186	29	$1,156	$500	$1,656
6	Base/Fill	16%	1.2	1.0				23	31	5	$178	$466	$644
6	Filter structure exavate	1	1.30	101.0	24.0	14.0	45	2,179	2,794	283	$11,121	$6,697	$17,818
6	Base/Fill	7%	1.2	1.0				153	206	22	$854	$3,066	$3,920
6	Filter chem slab excavate	1	1.30	33.0	15.0	2.0	45	44	57	9	$358	$153	$511
6	Base/Fill	50%	1.2	1.0				22	30	4	$171	$443	$614
6	Filter comp slab excavate	1	1.30	30.0	12.0	2.0	45	33	43	7	$270	$115	$385
6	Base/Fill	50%	1.2	1.0				17	22	3	$129	$334	$463
7	UV canopy pad excavate	10	1.30	3.0	3.0	3.0	45	37	47	8	$300	$127	$427
7	Base/Fill	33%	1.2	1.0				12	16	2	$94	$243	$338
7	UV channel area excavate	1	1.30	78.0	15.0	4.3	45	248	318	49	$1,941	$850	$2,791
7	Base/Fill	25%	1.2	1.0				62	84	12	$468	$1,245	$1,713

MWH CONSTRUCTORS

DIV 2 (Sitework) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

8	Utility water PS excavate	1	1.30	30	25	13.0	45	718	921	131	$5,148	$2,400	$7,548
8	Base/Fill	7%	1.2	1.0				50	68	9	$356	$1,010	$1,366
9	Pond # 1 excavate	1	1.50	695.0	154.0	6.0	30	25,750	33,024	896	$35,195	$79,297	$114,492
	Base/Fill NR	0%	0.0	1.0									
9	Pond # 2 excavate	1	1.50	636.0	154.0	6.0	30	23,594	30,260	821	$32,249	$72,659	$104,908
	Base/Fill NR	0%	0.0	1.0									
10	Dewater bldg area excavate	1	1.30	61.0	57.0	3.0	45	426	547	82	$3,233	$1,448	$4,681
10	Base/Fill	33%	1.2	1.0				141	190	26	$1,038	$2,828	$3,866
10	Dewater hopper excavate	1	1.30	22.5	22.5	3.0	45	72	92	15	$581	$249	$830
10	Base/Fill	33%	1.2	1.0				24	32	5	$184	$477	$661
11	Drain sump excavate	1	1.30	20.0	20.0	23.0	90	341	437	67	$2,625	$1,163	$3,788
11	Base/Fill	4%	1.2	1.0				14	18	3	$102	$274	$376
12	WRF biofilter area excavate	1	1.30	55.0	41.0	3.0	45	283	363	56	$2,205	$969	$3,175
12	Base/Fill	33%	1.2	1.0				93	126	18	$703	$1,879	$2,582
13	Ops bldg area excavate	1	1.30	64.0	42.0	2.0	45	215	276	43	$1,695	$739	$2,435
13	Base/Fill	50%	1.2	1.0				108	145	21	$817	$2,162	$2,979
14	MCC/genset slab excavate	1	1.30	82.0	25.0	2.0	45	168	215	34	$1,335	$579	$1,914
14	Base/Fill	33%	1.2	1.0				55	75	11	$424	$1,115	$1,538
	(structure excavate ID)	0	0.00	0.0	0.0	0.0	0						
	Base/Fill NR	0%	0.0	0.0									
	(structure excavate ID)	0	0.00	0	0	0	0						
	Base/Fill NR	0%	0.0	0.0									
	(trench ID)	0	0.0	0	0.0	0.0	0						
	Bed/Fill NR	0	0.0	0.0				0.00					
	(fine grade/contour ID)	0	0.0	0	0	0.00	0						
	Fill NR	0%	0.0										
	(temp dewatering ID)	0	0.0										
	(temp erosion control ID)	0	0.0										
1	Paxton MH & PS area shoring	1	7.0	37.0	17.5	20.0	2.00	2,180		178	$6,984	$5,126	$12,110
11	Drain sump area shoring	1	7.0	20.0	20.0	23.0	2.00	1,840		150	$5,894	$4,760	$10,654
	(temp wood bracing ID)	0	7.0	0	0	0	0.00						
	(temp wood bracing ID)	0	7.0	0	0	0	0.00						
	Subtotal - Site Grading & Excavation									5,065	$199,064	$328,410	**$527,475**

Site Improvements

#	Name or Location	Qty	Type	Long	Wide-Ø	Deep	Cut °	Thk/SF	Tons	MH	MH @ $39	M&E	BARE TOTAL
	(deep foundation ID)	0	0.0	0	0.0	0							
	EQ Mob/Demob/Test NR	0	0.0										
15	Paxton PS asphalt paving	1	1.2	16	16	0.0	0	0.54	11	19	$759	$672	$1,432
15	Sub-Base	1	1.2					0.81	17	10	$396	$246	$642
15	WRF asphalt paving	1	1.2	309	309	0.0	0	0.54	4,075	4,546	$178,667	$250,811	$429,478
15	Sub-Base	1	1.2					0.81	6,166	2,372	$93,218	$91,825	$185,043
	(asphalt pavement ID)	0	0.0	0	0	0.0	0	0.00					
	Sub-Base NR	0	0.0					0.00					
	(soil liner system ID)	0	0.0	0	0	0.0	0						
	Base/Overlay NR	0	0.0					0.00					
	(other base/overlay ID)	0	0.0	0	0	0.0	0	0.00					
	(stormwater system ID)	0	0.0	0	0								
13	Work area fence/gate allow	1	1.5	85	0	8.0				43	$1,703	$3,104	$4,807
15	Paxton PS fence/gate allow	1	1.5	125	120	8.0				250	$9,819	$17,893	$27,713
15	WRF fence/gate allow	1	1.5	1245	850	8.0				2,137	$83,967	$153,005	$236,972
	(fencing ID)	0	0.0	0	0	0.0							
	(landscape system ID)	0	0.00	0	0								
	Miscellaneous Work NR	0											
	Demolition Work NR	0											
	Subtotal - Site Improvements									9,377	$368,530	$517,557	**$886,087**

MWH CONSTRUCTORS

DIV 2 (Sitework) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Site Installation Allowances

#	Description	Qty	Type	MH	MH @ $0	M&E	BARE TOTAL
15	Survey, Layout, & Stake	1	4.0	168	$6,594	$5,526	$12,120
15	Plant & Structure Protection	1	4.0	336	$13,187	$11,053	$24,240
15	Site & Topsoil Clear	1	4.0	503	$19,781	$16,579	$36,360
15	Rough Grade & Contour	1	4.0	537	$21,099	$17,685	$38,784
15	Fine Grade & Contour	1	4.0	268	$10,550	$8,842	$19,392
15	Water & Drainage Control	1	4.0	1,342	$52,749	$44,212	$96,961
15	Patch, Repair, & Restore	1	4.0	1,007	$39,561	$33,159	$72,720
15	Seed/Sod & Xeriscape	1	4.0	839	$32,968	$27,632	$60,600
	Subtotal - Site Installation Allowances			5,000	$196,489	$164,689	**$361,178**

DIV 2 Sitework Totals

	MH	MH @ $39	M&E	BARE TOTAL
DIV 2 Totals	19,442	$764,083	$1,010,656	**$1,774,739**

MWH CONSTRUCTORS

DIVS 3-4 (Concrete & Masonry) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIVS 3-4

Scope Clarifications

Cement Material	Type II (low heat/sulfate resist)	*Minimum Thickness: SOG*	8"
Additive Components	1 Admixture	*Minimum Thickness: SAG*	8"
Concrete Mix Strength	4,000 psi (~ 7 bag/CY)	*Tank Base Slab Extension*	1½' Past Wall (each side)
ACI Installation Code	ACI 350R (environmental)	*Components: Round Clarifier*	
Reinforcement Material	A615-Plain Steel Rebar	*Components: Square Clarifier*	
Foundation Scope	Monolithic Haunch (thcknd edge)	*Raised Channel/Trough Scope*	
Foundation Width	1½' (excludes haunch slope)	*Rebar Density: All Concrete*	Normal
Foundation Depth	1½' (includes top-mount slab)	*Rebar Density: Buried Concrete*	Normal
Footer Width	2x Foundation Width	*Site Installation Allowances*	Low Density
Haunch Inside Slope	45° from horizontal	*Masonry Unit Scope*	
Embedments Scope	Typical Types & Densities	*Masonry Unit Cell Treatment*	

DIV 3 Concrete Scope

Rectangular Slabs & Foundations

#	Name or Location	Qty	Type	Long	Wide-Ø	Fndtn	Col	T-S	Exist?	Component	Thick	MH	MH @ $51	M&E	BARE TOTAL
1	Paxton PS MH base slab	1	3.0	5.0	5.0	3	0	0	0	*Thknd Base Slab*	1.00	14	$719	$329	$1,049
					Total $	$1,049									
					Total CY	1									
1	Paxton PS bldg slab	1	3.0	45.0	15.0	2	0	1	0	*Base Slab*	0.67	126	$6,350	$4,087	$10,437
					Total $	$13,879				*Haunch*	0.93	39	$1,958	$1,484	$3,442
					Total CY	24									
2	HW area grit pump slab	1	3.0	22.0	20.0	2	0	1	0	*Base Slab*	0.67	82	$4,139	$2,664	$6,803
					Total $	$9,136				*Haunch*	0.93	26	$1,327	$1,006	$2,333
					Total CY	16									
3	Ditch cover slab columns	20	3.0	1.5	1.5	4	20.0	0	0						
					Total $	$118,248				*Rect Column*	19.00	1,782	$90,113	$18,584	$108,697
					Total CY	38				*Spread Footer*	1.00	150	$7,586	$1,966	$9,551
4	ML splitter lean fill	2	3.0	7.0	4.0	5	0	0	0	*Lean Concrete*	8.00	17	$868	$3,054	$3,923
					Total $	$3,923									
					Total CY	17									
6	Compressor slab	1	3.0	25.0	10.0	2	0	1	0	*Base Slab*	0.84	58	$2,948	$1,898	$4,846
					Total $	$7,526				*Haunch*	0.74	37	$1,882	$798	$2,680
					Total CY	11									
7	UV canopy piers/footers	10	3.0	2.0	2.0	4	2.0	0	0						
					Total $	$20,795				*Rect Column*	2.00	211	$10,671	$1,961	$12,631
					Total CY	9				*Spread Footer*	1.00	128	$6,456	$1,707	$8,163
7	UV channel area slab	1	3.0	73.0	6.7	2	0	1	0	*Base Slab*	0.67	91	$4,601	$2,962	$7,563
					Total $	$12,219				*Haunch*	0.93	52	$2,648	$2,008	$4,656
					Total CY	22									
7	UV area misc equip pads	2	3.0	4.0	3.0	2	0	1	0	*Base Slab*	0.84	20	$1,008	$259	$1,267
					Total $	$2,143				*Haunch*	0.74	13	$668	$208	$876
					Total CY	1									
8	Utility water PS lean fill	1	3.0	20.0	4.0	5	0	0	0	*Lean Concrete*	8.00	26	$1,313	$4,488	$5,801
					Total $	$5,801									
					Total CY	24									
10	Dewater bldg slab balance	1	3.0	52.0	22.5	2	0	1	0	*Base Slab*	0.84	273	$13,798	$8,883	$22,681
					Total $	$25,975				*Haunch*	0.74	37	$1,873	$1,420	$3,294
					Total CY	44									
12	Paxton biofilter fan slab	1	3.0	12.0	12.0	2	0	1	0	*Base Slab*	0.84	44	$2,227	$1,150	$3,377
					Total $	$5,596				*Haunch*	0.74	32	$1,635	$584	$2,218
					Total CY	7									
12	WRF biofilter fan slab	1	3.0	36.0	18.0	2	0	1	0	*Base Slab*	0.84	151	$7,642	$4,920	$12,562
					Total $	$14,899				*Haunch*	0.74	26	$1,329	$1,008	$2,337
					Total CY	25									

MWH CONSTRUCTORS

DIVS 3-4 (Concrete & Masonry) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

13	Ops bldg slab	1	3.0	42.0	35.0	2	0	1	0	Base Slab	0.67	274	$13,828	$8,902	$22,729
					Total $	$27,219				Haunch	0.93	51	$2,554	$1,936	$4,490
					Total CY	46									
13	Ops bldg canopy slab	1	3.0	43.0	17.0	2	0	1	0	Base Slab	0.84	171	$8,621	$5,550	$14,171
					Total $	$16,788				Haunch	0.74	29	$1,489	$1,129	$2,617
					Total CY	28									
14	MCC/genset slab	1	3.0	75.0	20.0	2	0	1	0	Base Slab	0.84	350	$17,690	$11,388	$29,078
					Total $	$33,328				Haunch	0.74	48	$2,417	$1,833	$4,250
					Total CY	56									
		0	0.0	0	0.0	0	0	0	0						

Subtotal - Rectangular Slabs & Foundations	4,359	$220,357	$98,165	$318,523

Circular Tanks & Walls

#	Name or Location	Qty	Type	Ø	Hi-Dp	Wall	T-B	Fndtn	Tot Ext	Component	Thick	MH	MH @ $51	M&E	BARE TOTAL
3	Ditch end structures	2	3.0	63.0	20.0	1.0	1.0	3	0.0	Thknd Base Slab	1.50	1,651	$83,457	$94,771	$178,228
				Total $	$703,281				Stretch						
				Usable GAL	886,048				0.0						
				Freeboard VLF	1.00				Bury						
				Total CY	830				0	Walls	1.50	7,672	$387,899	$137,154	$525,053
		0	0.0	0	0	0.0	0.0	0	0.0						
									Stretch						
									0.0						
									Bury						
									0						

Subtotal - Circular Tanks & Walls	9,323	$471,355	$231,925	$703,281

Rectangular Tanks & Walls

#	Name or Location	Qty	Type	Long	Wide	Hi-Dp	T-B	Fndtn	Tot Ext	Component	Thick	MH	MH @ $51	M&E	BARE TOTAL
1	Paxton PS structure	1	3.0	17.5	7.5	20.0	1.0	3	3.0	Thknd Base Slab	1.17	57	$2,870	$3,213	$6,083
				Total $	$62,709				Walls						
				Usable GAL	18,653				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	60				0	Walls	1.17	831	$41,989	$14,637	$56,626
2	HW structure	1	3.0	76.5	76.5	8.0	1.0	3	3.0	Thknd Base Slab	1.17	1,296	$65,541	$73,378	$138,919
				Total $	$346,153				Walls						
				Usable GAL	306,424				3.13						
				Freeboard VLF	1.00				Bury						
				Total CY	459				0	Walls	1.17	3,161	$159,816	$47,418	$207,233
2	HW cover slabs	1	3.0	29.0	29.0	0.0	2.0	0	0.0						
				Total $	$29,218				Walls	Raised Slab	0.74	441	$22,306	$6,911	$29,218
									0.00						
									Bury						
				Total CY	23				0						
3	Anoxic zone structure	1	3.0	122.0	87.0	16.0	1.0	3	3.0	Thknd Base Slab	1.25	2,439	$123,298	$138,042	$261,341
				Total $	$570,484				Walls						
				Usable GAL	1,190,891				1.77						
				Freeboard VLF	1.00				Bury						
				Total CY	823				0	Walls	1.25	4,517	$228,351	$80,793	$309,144
3	Ditch cover slabs	2	3.0	76.0	76.0	0.0	2.0	0	0.0						
				Total $	$361,638				Walls	Raised Slab	0.67	5,461	$276,092	$85,547	$361,638
									0.00						
									Bury						
				Total CY	287				0						
3	Ditch center structure	1	3.0	192.0	125.0	16.0	1.0	3	3.0	Thknd Base Slab	1.50	6,436	$325,404	$364,316	$689,720
				Total $	$1,647,388				Walls						
				Usable GAL	2,692,800				3.02						
				Freeboard VLF	1.00				Bury						
				Total CY	2,300				0	Walls	1.50	13,992	$707,388	$250,281	$957,668

MWH CONSTRUCTORS

DIVS 3-4 (Concrete & Masonry) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

4	ML splitter structure	1	3.0	15.0	9.5	13.0	1.0	3	3.0	Thknd Base Slab	1.17	58	$2,954	$3,307	$6,261
				Total $	$53,458				Walls						
				Usable GAL	12,791				2.80						
				Freeboard VLF	1.00				Bury						
				Total CY	55				0	Walls	1.17	690	$34,863	$12,335	$47,197
4	Scum tank structure	2	3.0	6.0	6.0	14.0	1.0	3	3.0	Thknd Base Slab	1.00	51	$2,579	$2,350	$4,929
				Total $	$28,622				Walls						
				Usable GAL	7,001				1.50						
				Freeboard VLF	1.00				Bury						
				Total CY	31				0	Walls	1.00	345	$17,435	$6,257	$23,692
5	RAS/WAS structure	1	3.0	44.0	24.0	13.0	1.0	3	3.0	Thknd Base Slab	1.17	280	$14,166	$15,860	$30,025
				Total $	$118,376				Walls						
				Usable GAL	94,787				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	142				0	Walls	1.17	1,291	$65,261	$23,090	$88,350
6	Chem slab & curb	1	3.0	28.0	10.0	0.5	1.0	1	0.0	Base Slab	1.00	89	$4,479	$2,883	$7,362
				Total $	$18,517				Walls						
				Usable GAL	1,047				2.26	Fndtn Walls	0.56	83	$4,175	$546	$4,721
									Bury						
				Total CY	14				0	Curbing	0.50	119	$6,026	$408	$6,434
6	Flash mix tank structure	1	3.0	15.0	15.0	15.0	1.0	3	3.0	Thknd Base Slab	1.34	95	$4,793	$5,366	$10,159
				Total $	$64,403				Walls						
				Usable GAL	23,562				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	70				0	Walls	1.34	793	$40,068	$14,176	$54,244
6	Filter structure	1	3.0	91.0	14.0	17.0	1.0	3	3.0	Thknd Base Slab	1.17	361	$18,232	$20,413	$38,645
				Total $	$339,251				Walls						
				Usable GAL	152,472				3.41						
				Freeboard VLF	1.00				Bury						
				Total CY	350				0	Walls	1.17	4,392	$222,045	$78,561	$300,606
7	UV channel ends	2	3.0	7.0	4.0	10.0	1.0	3	3.0	Thknd Base Slab	1.00	56	$2,808	$2,194	$5,002
				Total $	$28,098				Walls						
				Usable GAL	3,770				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	27				0	Walls	1.00	351	$17,754	$5,343	$23,096
7	UV channel	1	3.0	62.0	3.0	4.3	1.0	3	3.0	Thknd Base Slab	0.84	71	$3,598	$4,028	$7,625
				Total $	$28,326				Walls						
				Usable GAL	4,522				1.91						
				Freeboard VLF	1.00				Bury						
				Total CY	33				0	Walls	0.84	316	$15,964	$4,737	$20,701
8	Utility water PS structure	1	3.0	20	15	13	1.0	3	3.0	Thknd Base Slab	1.17	100	$5,044	$5,647	$10,690
				Total $	$84,325				Walls						
				Usable GAL	26,928				3.14						
				Freeboard VLF	1.00				Bury						
				Total CY	88				0	Walls	1.17	1,076	$54,390	$19,244	$73,634
10	Dewater BFP base/pit	1	3.0	52.0	33.5	2.0	1.0	3	3.0	Thknd Base Slab	1.00	363	$18,354	$20,549	$38,903
				Total $	$54,724				Walls						
				Usable GAL	13,030				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	94				0	Walls	1.00	246	$12,416	$3,406	$15,822
10	Sludge hopper base/pit	1	3.0	17.5	17.5	2.0	1.0	3	3.0	Thknd Base Slab	1.50	137	$6,928	$7,757	$14,685
				Total $	$24,992				Walls						
				Usable GAL	2,291				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	39				0	Walls	1.50	160	$8,088	$2,219	$10,307
11	Drain sump structure	1	3.0	10.0	10.0	23.0	1.0	3	3.0	Thknd Base Slab	1.34	55	$2,755	$3,085	$5,840
				Total $	$67,710				Walls						
				Usable GAL	16,456				2.00						
				Freeboard VLF	1.00				Bury						
				Total CY	64				0	Walls	1.34	907	$45,877	$15,993	$61,870

DIVS 3-4 (Concrete & Masonry) - Class 4 OPCC

MWH CONSTRUCTORS

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

12	Paxton biofilter structure	1	3.0	24.0	12.0	1.5	1.0	2	3.0	*Base Slab*	0.84	112	$5,642	$3,632	$9,274
				Total $	$19,932				Walls						
				Usable GAL	1,077				2.00	*Haunch*	0.74	35	$1,752	$915	$2,666
				Freeboard VLF	1.00				Bury						
				Total CY	22				0	*Walls*	0.84	136	$6,862	$1,129	$7,991
12	WRF biofilter structure	1	3.0	36.0	32.0	1.5	1.0	2	3.0	*Base Slab*	0.84	348	$17,598	$11,328	$28,926
				Total $	$40,111				Walls						
				Usable GAL	4,308				2.00	*Haunch*	0.74	37	$1,847	$1,400	$3,247
				Freeboard VLF	1.00				Bury						
				Total CY	60				0	*Walls*	0.84	123	$6,229	$1,709	$7,938
		0	0.0	0	0	0	0.0	0	0.0						
									Walls						
									0.00						
									Bury						
									0						
Subtotal - Rectangular Tanks & Walls												51,902	$2,624,032	$1,364,402	**$3,988,435**

Round Clarifiers & Thickeners

#	Name or Location	Qty	Type	Ø	Hi-Dp	Tot Ext			Component	Thick	MH	MH @ $51	M&E	BARE TOTAL
4	Clarifier structures	2	3.0	70	14	3.0	Tot $	$707,139	*Slab & Cntr Well*	2.00	2,880	$145,615	$165,357	$310,971
				Bury			Usable GAL	748,449	*Walls*	1.25	4,595	$232,305	$83,366	$315,671
				0.0			Freeboard VLF	1.00	*O'flow Trough*	0.75	880	$44,472	$13,779	$58,251
							Total CY	1,059	*Rake Grouting*	0.21	248	$12,551	$9,695	$22,245
		0	0.0	0	0	0.0								
				Bury										
				0.0										
Subtotal - Round Clarifiers & Thickeners											8,603	$434,942	$272,197	**$707,139**

Site Installation Allowances

#	Name or Location	Qty	Type	Style	Long	Wide	Deep	Thick	SF	MH	MH @ $51	M&E	BARE TOTAL
15	Door Pads & Aprons	1	3.0	2.0						1,625	$82,151	$55,001	$137,151
15	EQ Bases & Stands	1	3.0	2.0						1,016	$51,344	$34,375	$85,720
15	Housekeeping Pads	1	3.0	2.0						2,031	$102,688	$68,751	$171,439
15	DIV 5 Pads & Piers	1	3.0	2.0						635	$32,090	$21,485	$53,575
15	Walks, Ramps, & Stairs	1	3.0	2.0						853	$43,129	$28,875	$72,004
	(yard utilidor ID)	0	0.0	0.0	0	0	0	0.00					
								0.00					
Subtotal - Site Installation Allowances										6,159	$311,402	$208,487	**$519,889**

DIV 4 Masonry Scope

#	Name or Location	Qty	Type	Treat	Long	Wide	Hi-Dp	Thick	SF	MH	MH @ $0	M&E	BARE TOTAL
	(masonry structure ID)	0	0.0	0.0	0	0	0						
	(masonry structure ID)	0	0.0	0.0	0	0	0						
Subtotal - Masonry Walls & Structures													

DIVS 3-4 Concrete & Masonry Totals

	Concrete CY		MH	MH @ $51	M&E	BARE TOTAL
DIVS 3-4 Totals	8,221		80,346	$4,062,089	$2,175,176	**$6,237,266**

MWH CONSTRUCTORS

DIV 5 (Metals) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIV 5

Scope Clarifications

Metals Supplier	MWHC or Subcontractor	*Tank Fabrication Site*	
Accessway Material	Aluminum	*Tank Shell: Material*	
CIP Hatch Material	Aluminum	*Tank Shell: Thickness*	
Hoist Material & Style	Varies by Structure	*Tank Finish: Interior*	
Bollard Material & Style	CS Galvanized-8"Ø	*Tank Finish: Exterior*	
Bent Material & Style		*(un-assigned)*	

DIV 5 Metals Scope

Walkway Assemblies

#	Name or Location	Qty	Type	Long	Wide-Ø	High	SF	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
3	Common anoxic	1	2.39	117.0	3.5	1.0	410	43	$2,073	$4,272	2.1	$34,172
3	Ox ditch centers	2	2.39	130.0	3.5	1.0	910	96	$4,608	$9,492	4.8	$75,938
3	Ox ditch ML area	2	2.39	5.0	3.5	1.0	35	7	$344	$503	0.2	$4,025
		0	2.39	0	0.0	0						
		0	2.39	0	0.0	0						
	Subtotal - Walkway Assemblies						1,355	146	$7,025	$14,267	7.1	**$114,135**

Platform & Landing Assemblies

#	Name or Location	Qty	Type	Long	Wide-Ø	High	SF	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
3	Anoxic area mixer bridge	2	2.39	62.0	5.0	1.0	620	106	$5,085	$7,999	3.1	$63,990
6	Flash mix tank	1	2.39	18.0	5.0	4.0	90	19	$895	$1,335	0.5	$10,677
10	BFP mezzanine	1	2.39	25.0	25.0	5.0	625	87	$4,172	$7,238	3.1	$57,902
		0	2.39	0	0	0						
		0	2.39	0	0	0						
	Subtotal - Platform & Landing Assemblies						1,335	211	$10,151	$16,571	6.7	**$132,569**

Stairway Assemblies

#	Name or Location	Qty	Type	Wide	High	Type	Risers	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
2	HW grit pump area	1	2.39	3.5	8.0	1.5	12	26	$1,234	$696	0.3	$5,569
3	Common anoxic walkway	1	2.39	3.5	5.0	1.0	8	14	$661	$341	0.1	$2,729
3	Ox ditch center walkways	4	2.39	3.5	5.0	1.0	32	55	$2,646	$1,365	0.5	$10,916
3	Ox ditch ML walkways	2	2.39	3.5	5.0	1.0	16	28	$1,323	$682	0.3	$5,458
3	Ox ditch	4	2.39	3.5	8.0	1.5	48	103	$4,937	$2,785	1.1	$22,276
4	Clarifier	2	2.39	3.5	7.0	1.5	22	46	$2,227	$1,218	0.5	$9,746
4	ML splitter	1	2.39	3.5	7.0	1.5	11	23	$1,114	$609	0.2	$4,873
5	RAS/WAS pump pit	1	2.39	3.5	13.0	1.5	20	35	$1,692	$1,131	0.4	$9,050
6	Flash mix tank	1	2.39	3.5	9.0	1.5	14	28	$1,345	$783	0.3	$6,265
6	Filter structure	2	2.39	3.5	4.0	1.5	12	29	$1,388	$696	0.3	$5,569
10	BFP mezzanine	1	2.39	3.5	5.0	1.5	8	18	$844	$435	0.2	$3,481
10	Sludge hopper	1	2.39	3.0	18.0	1.5	27	36	$1,740	$1,428	0.5	$11,423
		0	2.39	0.0	0	0.0						
		0	2.39	0.0	0	0.0						
	Subtotal - Stairway Assemblies						230	441	$21,151	$12,169	4.6	**$97,356**

Ladder Assemblies

#	Name or Location	Qty	Type	Wide	High	Type	VLF	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
1	Paxton PS structure-FRP	1	3.02	1.34	20.0	1.5	20	26	$1,256	$514	0.1	$4,111
8	Utility water PS structure-FRP	3	3.02	1.34	13.0	1.5	39	45	$2,147	$808	0.1	$6,465
11	Drain sump structure-FRP	1	2.39	1.34	23.0	1.5	23	27	$1,303	$483	0.1	$3,863
		0	2.39	0.00	0	0.0						
		0	2.39	0.00	0	0.0						
	Subtotal - Ladder Assemblies						82	98	$4,706	$1,805	0.3	**$14,440**

MWH CONSTRUCTORS

DIV 5 (Metals) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Handrail & Toeplate Assemblies

#	Name or Location	Qty	Type	Long	Wide-Ø	Type	HLF	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
1	HW structure	1	2.39	306.0	0.0	3.0	306	11	$538	$2,215	0.6	$17,719
3	Ox ditch tops	2	2.39	390.0	0.0	3.0	780	29	$1,370	$5,646	1.4	$45,165
4	ML splitter	1	2.39	16.0	10.5	3.0	53	11	$548	$479	0.1	$3,829
5	RAS/WAS pump pit	1	2.39	45.0	25.0	3.0	140	5	$246	$1,013	0.3	$8,107
6	Filter structure	1	2.39	92.0	15.0	3.0	214	8	$376	$1,549	0.4	$12,392
		0	2.39	0	0	0.0						
		0	2.39	0	0	0.0						
		0	2.39	0	0	0.0						
	Subtotal - Handrail & Toeplate Assemblies						1,493	64	$3,077	$10,901	2.7	**$87,211**

Grating & Coverplate Assemblies

#	Name or Location	Qty	Type	Long	Wide-Ø	Type	SF	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
1	Paxton PS structure	1	2.39	17.5	7.5	3.0	144	31	$1,471	$422	0.5	$6,747
2	HW structure	1	2.39	34.0	34.0	3.0	1,190	167	$7,997	$3,035	4.1	$48,557
4	ML splitter	1	2.39	15.0	9.5	3.0	155	32	$1,545	$450	0.5	$7,196
6	Filter structure	1	2.39	91.0	14.0	3.0	1,327	186	$8,914	$3,383	4.6	$54,125
7	UV channel	1	2.39	15.6	15.6	3.0	259	41	$1,978	$687	0.9	$10,985
8	Utility water PS structure	1	2.39	20.0	15.0	3.0	318	44	$2,135	$810	1.1	$12,963
10	BFP pit area	1	2.39	52.0	33.5	3.0	1,785	250	$11,993	$4,551	6.2	$72,820
10	Sludge hopper pad	1	2.39	17.5	17.5	4.0	324	52	$2,478	$940	1.3	$15,044
11	Drain sump	1	2.39	10.0	10.0	3.0	110	25	$1,209	$332	0.4	$5,310
		0	2.39	0	0	0.0						
		0	2.39	0	0	0.0						
		0	2.39	0	0	0.0						
	Bldg/Slab Utilidor Cover NR	0	2.39	0	0	0.0						
	Subtotal - Grating & Coverplate Assemblies						5,612	827	$39,720	$14,609	19.6	**$233,748**

Site Installation Allowances

#	Work Description	Qty	Type	Long	Wide-Ø	High	Type/SF	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
	Hatches, Scuttles, & Doors NR	0	2.40	0	0							
	Hoist & Lift Structures NR	0	0.00	0	0	0.0						
15	Guard Posts & Bollards	20	1.51		0.67	6.0	1	279	$13,405	$11,755	2.6	$23,509
	Bent & Support Structures NR	0	0.00	0	0	0	0					
	Yard Utilidor Cover NR	0	2.39	0	0	1.0						
	Subtotal - Site Installation Allowances							279	$13,405	$11,755	2.6	**$23,509**

Miscellaneous Assemblies

#	Work Description	Qty	Type	Long	Wide-Ø	High	Type	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
	(hatch ID)	0	2.40	0	0							
7	UV galv monorail	1	0.68	75.0	3.0	9.0		37	$1,755	$442	3.0	$7,071
10	Dewater bldg galv bridge rails	2	0.68	52.0	1.0	16.0		53	$2,557	$281	1.8	$4,499
13	Work area galv bridge rails	2	0.68	43.0	1.0	16.0		44	$2,135	$233	1.5	$3,733
	(hoist structure ID)	0	0.00	0	0	0.0						
15	Site bollard/guardpost allowance	20	1.51		0.67	7	1	279	$13,405	$13,714	3.1	$27,427
	(bollard ID)	0	1.51		0.67	0	0					
	(bent structure ID)	0	0.00	0	0	0	0					
	Miscellaneous Work NR	0										
	Subtotal - Miscellaneous Assemblies							414	$19,852	$14,670	9.4	**$42,730**

DIV 5 Metals Totals

	MH	MH @ $48	M&E	Tons	Buy-Out TOTAL
DIV 5 Totals	2,481	$119,089	$96,748	53.1	**$745,698**

MWH CONSTRUCTORS

DIV 9 (Coatings) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIV 9

Scope Clarifications

Floor & Wall Material	Blast & Urethane (spray-on)	*Apply: Edge-to-SF Ratio*	Low (single chamber tanks)
Pipe & Duct Material		*Apply: Scaffold Work*	Varies by Structure
System Material		*Apply: Contain & Clean*	Average

DIV 9 Coating Scope

Floors & Walls

#	Name or Location	Qty	Type	Long	Wide-Ø	Hi-Dp	T/B	Apply	SF	MH	MH @ $44	M&E	BARE TOTAL
1	Paxton PS MH interior	1	5.0	0.0	4.0	20.0	1	2.5	264	65	$2,862	$4,674	$7,536
1	Paxton PS interior	1	5.0	17.5	7.5	20.0	1	2.5	1,131	264	$11,692	$19,451	$31,143
2	HW tank OWL	1	5.0	445.0	0.0	4.0	0	2.2	1,780	353	$15,593	$28,978	$44,571
3	Ditch tank OWL	2	5.0	930.0	0.0	4.0	0	1.6	7,440	954	$42,192	$104,291	$146,483
4	Clar eff trough (int+ext OWL)	2	5.0	213.0	2.0	3.0	1	2.2	3,432	682	$30,178	$55,998	$86,177
4	ML splitter OWL	1	5.0	180.0	0.0	4.0	0	1.6	720	111	$4,898	$11,245	$16,143
4	Scum tank interior	2	5.0	6.0	6.0	14.0	1	2.5	744	181	$8,021	$13,129	$21,150
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
		0	5.0	0	0	0	0	1.6					
	OWL=operating water level	0	5.0	0	0	0	0	1.6					
	Subtotal - Floors & Walls								15,511	2,610	$115,436	$237,767	**$353,203**

Pipes & Ducts

#	Name or Location	Qty	Type	Long	Wide-Ø	High	Ftgs	Apply	SF	MH	MH @ $0	M&E	BARE TOTAL
		0	0.0	0	0	0	0	1.6					
		0	0.0	0	0	0	0	1.6					
	Subtotal - Pipes & Ducts												

System Allowances

#	Description	Qty	Type	Percent	Apply	MH	MH @ $0	M&E	BARE TOTAL
	DIV 5 Metals NR	0	0.0	0%	1.6				
	DIV 5 Tanks NR	0	0.0	0%	1.6				
	DIVS 11-15 Mechanical NR	0	0.0	0%	1.6				
	DIV 13 PE Structures NR	0	0.0	0%	1.6				
	DIV 13 PE Mezzanines NR	0	0.0	0%	1.6				
	DIV 13 Masonry Walls NR	0	0.0	0%	1.6				
	DIV 13 Welded Tanks NR	0	0.0	0%	1.6				
	DIV 13 Bolted Tanks NR	0	0.0	0%	1.6				
	DIV 15 Piping NR	0	0.0	0%	1.6				
	DIV 15 Ductwork NR	0	0.0	0%	1.6				
	DIV 15 EQ Internals NR	0	0.0	0%	1.6				
	DIV 15 Pipe Headers NR	0	0.0	0%	1.6				
	DIV 15 Tank Insulation NR	0	0.0	0%	1.6				
	DIV 16 Conduit NR	0	0.0	0%	1.6				
	DIVS 16-17 Gear NR	0	0.0	0%	1.6				
	Subtotal - System Allowances								

DIV 9 Finishes Totals

	SF	MH	MH @ $44	M&E	BARE TOTAL
DIV 9 Totals	15,511	2,610	$115,436	$237,767	**$353,203**

MWH CONSTRUCTORS

DIVS 11-17 (Equipment & Installation) - Class 4 OPCC

Project Name	Location	Estimator	Date	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	Jim Ward	29-Sep-08	001	7012451

DIVS 11-17 Equipment & Installation

			DIVS 11-17 Equipment	*DIV 15-Mechanical Installation (including applicable allowances)*				*DIV 16-Electrical Installation (including applicable allowances)*			
#	Equipment Item Description	Qty	BARE TOTAL	MH	MH $	M&E	BARE TOTAL	MH	MH $	M&E	BARE TOTAL
	Influent Pumping										
1	Precast MH & CI cover-4' Ø x 20' (DIV 2)	1	$2,500	18	$1,012	$2,011	$3,023				
1	PS structure-17.5' x 7.5' x 20' (DIVS 2-3)	1		53	$3,037	$6,032	$9,068				
1	3' x 3' slide gate-motorized-SS	1	$10,000	26	$1,500	$927	$2,427				
1	480 VAC power	1						12	$561	$931	$1,492
1	120 VAC signal	1						15	$702	$1,164	$1,866
1	Ultrasonic level LIT	1	$1,600	11	$643	$397	$1,040				
1	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
1	Hi/Lo float safety level switch assembly	1	$350	6	$369	$624	$992	9	$401	$665	$1,066
1	Slide rail sub pumps-1,400 gpm @ 100'-CI	4	$90,000	181	$10,321	$17,459	$27,780				
1	480 VAC power	4						171	$7,858	$13,037	$20,895
1	120 VAC signal	4						44	$2,005	$3,326	$5,330
1	VFD unit (50 hp)	4	$42,000					98	$4,490	$7,449	$11,940
1	Discharge PS/PI assembly	4	$3,000	19	$1,106	$1,871	$2,976	26	$1,203	$1,995	$3,198
1	8" magnetic flowmeter FIT	1	$4,000	14	$804	$497	$1,300				
1	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
1	Automatic sampler (refrigerated composite)	1	$6,000	6	$362	$718	$1,080				
1	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
1	Bldg structure-45' x 15' (DIVS 2,3,13)	1		81	$4,608	$7,794	$12,402	109	$5,011	$8,314	$13,326
1	500 kW diesel generator w/ belly tank & ATS	1	$80,000	139	$7,925	$8,774	$16,700	187	$8,620	$14,300	$22,920
	MCC generator tie allowances	2									
	Headworks										
2	Grit bldg area-35' x 17'	1		71	$4,055	$6,859	$10,914	96	$4,410	$7,316	$11,727
2	HW structure-76.5' x 76.5' x 8' (DIVS 2-3)	1		152	$8,676	$17,233	$25,910				
2	48" inlet flume insert-FRP	1	$2,500	26	$1,500	$927	$2,427				
2	Ultrasonic inlet flow FIT	4	$6,400	45	$2,572	$1,590	$4,161				
2	120 VAC power & signal	4						98	$4,490	$7,449	$11,940
2	30" x 72" gate-manual-SS (screens)	6	$69,000	124	$7,072	$4,371	$11,443				
2	30" x 84" gate-manual-SS (Pista inlet)	1	$12,500	23	$1,286	$795	$2,081				
2	60" x 72" gate-manual-SS (splitter)	1	$19,500	26	$1,500	$927	$2,427				
2	66" x 72" gate-manual-SS (Pista outlet)	1	$21,500	28	$1,607	$993	$2,601				
2	72" x 72" gate-manual-SS (bypass)	1	$21,500	30	$1,714	$1,060	$2,774				
2	Ultrasonic level LIT (mech screen channels)	4	$6,400	45	$2,572	$1,590	$4,161				
2	120 VAC power & signal	4						98	$4,490	$7,449	$11,940
2	Hi/Lo float safety level switch assembly	2	$700	13	$737	$1,247	$1,984	17	$802	$1,330	$2,132
2	Static bar screen-2.5' x 6' 316 SS	1	$3,500	15	$857	$530	$1,387				
2	Mechanical bar screen-2.5' x 6'-316 SS	2	$150,000	139	$7,929	$4,901	$12,830				
2	480 VAC power	2						55	$2,526	$4,190	$6,716
2	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
2	Combined discharge conveyor-10" x 25'-SS	1	$41,500	19	$1,072	$662	$1,734				
2	480 VAC power	1						27	$1,263	$2,095	$3,358
	(cont'd next page)										
	Power Supply & SCADA (DIVS 16-17)										
14	Master Control Panel Equipment	1	$162,055					262	$12,028	$19,954	$31,981
14	120 VAC SCADA Equipment	1	$485,735					327	$15,034	$24,942	$39,977
14	480 VAC MCC & Transformer Equipment	1	$352,993					968	$44,502	$73,829	$118,331
14	Field HOA Switches	74						645	$29,668	$49,220	$78,888
	EQ & Installation Sheet 1 Totals		**$1,595,233**	1,314	$74,836	$90,789	**$165,625**	3,386	$155,676	$258,270	**$413,946**

DIVS 11-17 (Equipment & Installation) - Class 4 OPCC

MWH CONSTRUCTORS

Project Name	Location	Estimator	Date	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	Jim Ward	29-Sep-08	001	7012451

DIVS 11-17 Equipment & Installation

			DIVS 11-17 Equipment	DIV 15-Mechanical Installation (including applicable allowances)				DIV 16-Electrical Installation (including applicable allowances)			
#	Equipment Item Description	Qty	BARE TOTAL	MH	MH $	M&E	BARE TOTAL	MH	MH $	M&E	BARE TOTAL
2	Combined screen washer/compactor-316 SS	1	$45,000	40	$2,250	$1,391	$3,641				
2	480 VAC power	1						27	$1,263	$2,095	$3,358
2	480 VAC power	1						31	$1,403	$2,328	$3,731
2	480 VAC power	1						27	$1,263	$2,095	$3,358
2	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
2	1" flush solenoid & bypass valve assembly	1	$550	13	$737	$1,247	$1,984				
2	120 VAC power	1						15	$702	$1,164	$1,866
2	Pista grit separator package-16' Ø	1	$48,000	47	$2,679	$1,656	$4,335				
2	480 VAC power	1						27	$1,263	$2,095	$3,358
2	VFD unit (2 hp)	1	$2,500					18	$842	$1,397	$2,239
2	120 VAC panel power & signal	1						24	$1,123	$1,862	$2,985
2	1" flush solenoid & bypass valve assembly	1	$550	13	$737	$1,247	$1,984				
2	120 VAC power	1						15	$702	$1,164	$1,866
2	½" mix air solenoid station assembly	1	$350	8	$461	$779	$1,240				
2	120 VAC power	1						15	$702	$1,164	$1,866
2	Grit HC recessed pump-220 gpm @ 60'-CI	2	$35,000	142	$8,110	$13,718	$21,827				
2	480 VAC power	2						61	$2,806	$4,656	$7,462
2	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
2	120 VAC signal	2						31	$1,403	$2,328	$3,731
2	½" seal water solenoid station assembly	2	$700	16	$922	$1,559	$2,480				
2	120 VAC power	2						31	$1,403	$2,328	$3,731
2	1" flush solenoid & bypass valve assembly	2	$1,100	26	$1,474	$2,494	$3,969				
2	120 VAC power	2						31	$1,403	$2,328	$3,731
2	220 gpm grit cyclone/compactor-304 SS	1	$45,500	28	$1,607	$993	$2,601				
2	480 VAC power	1						24	$1,123	$1,862	$2,985
2	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
2	1" flush solenoid & bypass valve assembly	1	$550	13	$737	$1,247	$1,984				
2	120 VAC power	1						15	$702	$1,164	$1,866
2	Grit area sump pumps - 50 gpm @ 30'-CI	2	$7,000	37	$2,085	$3,527	$5,612				
2	480 VAC power	2						24	$1,123	$1,862	$2,985
2	120 VAC signal	2						31	$1,403	$2,328	$3,731
2	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
2	Hi/Lo float level switch assembly	1	$350	6	$369	$624	$992	9	$401	$665	$1,066
2	Eyewash/shower station	2	$1,700	26	$1,474	$2,494	$3,969				
2	120 VAC flow switch	2		10	$553	$935	$1,488	13	$601	$998	$1,599
2	Water tempering unit	1	$650	14	$776	$1,239	$2,015				
2	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
	Bioreactors										
3	Ditch structure-320' x 125' (DIVS 2-3)	1		367	$20,895	$41,504	$62,399				
3	96" x 48" gate-manual-SS (influent)	2	$43,000	56	$3,215	$1,987	$5,202				
3	48" x 48" gate-manual-SS (MLR)	2	$23,000	41	$2,357	$1,457	$3,814				
3	Ultrasonic level LIT (ditches)	2	$3,200	23	$1,286	$795	$2,081				
3	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
3	Hi/Lo float safety level switch assembly	2	$700	13	$737	$1,247	$1,984	17	$802	$1,330	$2,132
3	Anoxic mechanical mixer-vertical tubine	2	$47,000	72	$4,072	$2,517	$6,589				
3	480 VAC power	2						55	$2,526	$4,190	$6,716
3	120 VAC power	2						49	$2,245	$3,725	$5,970
3	120 VAC signal	4						61	$2,806	$4,656	$7,462
	EQ & Installation Sheet 2 Totals		**$309,400**	1,030	$58,640	$86,528	**$145,167**	801	$36,824	$61,092	**$97,916**

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Project Name	Location	Estimator	Date	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	Jim Ward	29-Sep-08	001	7012451

DIVS 11-17 Equipment & Installation

			DIVS 11-17 Equipment	*DIV 15-Mechanical Installation (including applicable allowances)*				*DIV 16-Electrical Installation (including applicable allowances)*			
#	Equipment Item Description	Qty	BARE TOTAL	MH	MH $	M&E	BARE TOTAL	MH	MH $	M&E	BARE TOTAL
3	Ditch mechanical aerator-fixed-SS	4	$258,000	143	$8,144	$5,034	$13,177				
3	480 VAC power	4						159	$7,297	$12,105	$19,402
3	VFD unit (30 hp)	4	$30,000					98	$4,490	$7,449	$11,940
3	120 VAC signal	8						122	$5,613	$9,312	$14,925
3	Dissolved oxygen AIT	4	$10,000	30	$1,714	$1,060	$2,774				
3	120 VAC power & signal	4						98	$4,490	$7,449	$11,940
	Clarifiers										
4	Clarifier/scum/bridge unit-70' Ø (DIVS 2-3)	2		569	$32,391	$64,338	$96,729				
4	Internals assembly-painted CS-70' x 14'	2	$245,000	452	$25,717	$15,896	$41,612				
4	480 VAC power	2						67	$3,087	$5,122	$8,209
4	120 VAC signal	4						61	$2,806	$4,656	$7,462
4	Ultrasonic level LIT (scum pits)	2	$3,200	23	$1,286	$795	$2,081				
4	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
4	Hi/Lo float safety level switch assembly	2	$700	13	$737	$1,247	$1,984	17	$802	$1,330	$2,132
4	Slide rail scum pump-120 gpm @ 50'	4	$22,000	155	$8,847	$14,965	$23,812				
4	480 VAC power	4						110	$5,052	$8,381	$13,432
4	120 VAC signal	4						61	$2,806	$4,656	$7,462
4	Discharge PS/PI assembly	4	$3,000	19	$1,106	$1,871	$2,976	26	$1,203	$1,995	$3,198
4	ML splitter structure-15' x 9.5' (DIVS 2-3)	1		53	$3,037	$6,032	$9,068				
4	66" x 36" gate-manual-SS	2	$23,000	41	$2,357	$1,457	$3,814				
4	Ultrasonic level LIT	2	$3,200	23	$1,286	$795	$2,081				
4	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
4	Hi/Lo float safety level switch assembly	2	$700	13	$737	$1,247	$1,984	17	$802	$1,330	$2,132
	RAS Pump Station										
5	Sub-structure-44' x 24' (DIVS 2,3,13)	1		91	$5,161	$8,729	$13,890	122	$5,613	$9,312	$14,925
5	RAS HC recessed pump-1050 gpm @ 50'-CI	3	$49,500	168	$9,577	$16,200	$25,777				
5	480 VAC power	3						110	$5,052	$8,381	$13,432
5	VFD unit (20 hp)	3	$13,500					55	$2,526	$4,190	$6,716
5	120 VAC signal	3						46	$2,105	$3,492	$5,597
5	Discharge PS/PI assembly	3	$2,250	15	$829	$1,403	$2,232	20	$902	$1,497	$2,399
5	½" seal water solenoid station assembly	3	$1,050	24	$1,382	$2,338	$3,721				
5	120 VAC power	3						46	$2,105	$3,492	$5,597
5	1" flush solenoid & bypass valve assembly	3	$1,650	39	$2,212	$3,741	$5,953				
5	120 VAC power	3						46	$2,105	$3,492	$5,597
5	12" magnetic flowmeter FIT	2	$13,000	38	$2,143	$1,325	$3,468				
5	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
5	WAS rotary lobe pump-300 gpm @ 130'-CI	2	$21,000	119	$6,777	$11,463	$18,241				
5	480 VAC power	2						73	$3,368	$5,587	$8,955
5	VFD unit (15 hp)	2	$10,000					37	$1,684	$2,794	$4,477
5	120 VAC signal	2						31	$1,403	$2,328	$3,731
5	Suction & Discharge PS/PI assembly	4	$3,000	19	$1,106	$1,871	$2,976	26	$1,203	$1,995	$3,198
5	½" seal water solenoid station assembly	2	$700	16	$922	$1,559	$2,480				
5	120 VAC power	2						31	$1,403	$2,328	$3,731
5	1" flush solenoid & bypass valve assembly	2	$1,100	26	$1,474	$2,494	$3,969				
5	120 VAC power	2						31	$1,403	$2,328	$3,731
5	4" Ø magnetic flowmeter FIT	1	$2,500	10	$589	$364	$954				
5	120 VAC power & signal feeds	1						24	$1,123	$1,862	$2,985
	EQ & Installation Sheet 3 Totals		**$718,050**	2,099	$119,532	$166,222	**$285,754**	1,679	$77,177	$128,038	**$205,214**

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DIVS 11-17 Equipment & Installation

			DIVS 11-17 Equipment	DIV 15-Mechanical Installation (including applicable allowances)				DIV 16-Electrical Installation (including applicable allowances)			
#	Equipment Item Description	Qty	BARE TOTAL	MH	MH $	M&E	BARE TOTAL	MH	MH $	M&E	BARE TOTAL
	Filters										
6	Flash mix tank-15' x 15' x 15' (DIVS 2-3)	1		66	$3,760	$7,468	$11,228				
6	Ultrasonic level LIT	1	$1,600	11	$643	$397	$1,040				
6	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
6	Rapid mix area mixer-vertical tubine	1	$23,500	36	$2,036	$1,258	$3,294				
6	480 VAC power	1						27	$1,263	$2,095	$3,358
6	120 VAC power	1						24	$1,123	$1,862	$2,985
6	120 VAC signal	2						31	$1,403	$2,328	$3,731
6	Flngd influent weir boxes-4' x 3' x 3'-304 SS	7	$24,500	72	$4,123	$2,549	$6,672				
6	Ultrasonic level LIT	7	$11,200	79	$4,500	$2,782	$7,282				
6	120 VAC power & signal	7						171	$7,858	$13,037	$20,895
6	Filter structure-91' x 14' (DIVS 2-3)	1		213	$12,147	$24,127	$36,273				
6	Internals & media package-200 sf (DIV 15)	6	$270,000								
6	480 VAC power	6						165	$7,577	$12,571	$20,148
6	120 VAC power & signal	6						146	$6,735	$11,174	$17,910
6	Screw air compressor-100 cfm @ 120 psi	2	$24,000	155	$8,847	$14,965	$23,812				
6	480 VAC power	2						85	$3,929	$6,518	$10,447
6	120 VAC power & signal	2						37	$1,684	$2,794	$4,477
6	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
6	Air receiver tank-4' x 6'-galv CS	1	$3,500	32	$1,843	$3,118	$4,961				
6	PS/PI assembly	1	$750	5	$276	$468	$744	7	$301	$499	$800
6	Neat polymer dilution/feed units-4 gph neat	2	$15,000	129	$7,372	$12,471	$19,843				
6	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
6	Neat polymer tote-4' Ø x 4'-330 gal-HDPE	1	$1,500	42	$2,396	$4,053	$6,449				
6	Hi/Lo float level switch assembly	1	$350	6	$369	$624	$992	9	$401	$665	$1,066
6	Alum tote-4' Ø x 4'-330 gal-HDPE	1	$1,500	42	$2,396	$4,053	$6,449				
6	Hi/Lo float level switch assembly	1	$350	6	$369	$624	$992	9	$401	$665	$1,066
6	Metering pump with SCR-8 gph	2	$19,000	46	$2,607	$4,409	$7,016				
6	480 VAC power	2						24	$1,123	$1,862	$2,985
6	120 VAC signal	2						31	$1,403	$2,328	$3,731
6	Eyewash/shower station	1	$850	13	$737	$1,247	$1,984				
6	120 VAC flow switch	1		5	$276	$468	$744	7	$301	$499	$800
6	Water tempering unit	1	$650	14	$776	$1,239	$2,015				
6	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
	UV Disinfection										
7	Channel-73' x 3' x 4' (DIVS 2-3)	1		160	$9,110	$18,095	$27,205				
7	Canopy structure-81' x 15' (DIVS 2,3,13)	1		65	$3,686	$6,235	$9,922	87	$4,009	$6,651	$10,660
7	36" x 51" gate-manual-SS	1	$10,500	15	$857	$530	$1,387				
7	Weighted swing gate-36" x 51"-SS	1	$7,500	15	$857	$530	$1,387				
7	Ultrasonic level LIT	2	$3,200	23	$1,286	$795	$2,081				
7	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
7	Hi/Lo float safety level switch assembly	2	$700	13	$737	$1,247	$1,984	17	$802	$1,330	$2,132
7	UV system/bank assemblies (5/channel)	5	$900,000	273	$15,519	$24,781	$40,300	234	$10,767	$17,862	$28,629
7	480 VAC UV system power	1						37	$1,684	$2,794	$4,477
7	120 VAC UV bank power & signal	5						122	$5,613	$9,312	$14,925
7	Monorail hoist drive-500 lb (DIV 5)	1	$1,500	11	$643	$397	$1,040				
7	480 VAC power	1						24	$1,123	$1,862	$2,985
7	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
	EQ & Installation Sheet 4 Totals		**$1,323,150**	1,558	$88,722	$139,863	**$228,585**	1,478	$67,958	$112,743	**$180,701**

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DIVS 11-17 Equipment & Installation

#	Equipment Item Description	Qty	DIVS 11-17 Equipment BARE TOTAL	DIV 15-Mechanical Installation (including applicable allowances) MH	MH $	M&E	BARE TOTAL	DIV 16-Electrical Installation (including applicable allowances) MH	MH $	M&E	BARE TOTAL
	Utility Water Pump Station										
8	Structure-20' x 15' x 13' (DIVS 2-3)	1		76	$4,338	$8,617	$12,955				
8	48" x 48" gate-manual-SS (chamber isolate)	2	$23,000	41	$2,357	$1,457	$3,814				
8	24" x 24" gate-manual-SS (pond isolate)	2	$10,000	19	$1,072	$662	$1,734				
8	Ultrasonic level LIT	1	$1,600	11	$643	$397	$1,040				
8	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
8	Hi/Lo float safety level switch assembly	1	$350	6	$369	$624	$992	9	$401	$665	$1,066
8	Slide rail water pump-100 gpm @130'-CI	3	$16,500	117	$6,635	$11,224	$17,859				
8	480 VAC power	3						92	$4,210	$6,984	$11,194
8	120 VAC signal	3						46	$2,105	$3,492	$5,597
8	Discharge PS/PI assembly	3	$2,250	15	$829	$1,403	$2,232	20	$902	$1,497	$2,399
	Percolation Ponds										
9	Pond # 1 structure-107,100 sf (DIV 2)	1		146	$8,286	$16,458	$24,744				
9	Pond # 2 structure-97,900 sf (DIV 2)	1		143	$8,134	$16,156	$24,290				
	Sludge Dewatering										
10	Bldg structure-56' x 52' (DIVS 2,3,13)	1		139	$7,925	$13,406	$21,331	187	$8,620	$14,300	$22,920
10	BFP skid package-2 belt-2M-Galv CS	2	$520,000	388	$22,117	$37,412	$59,529				
10	480 VAC power	2						73	$3,368	$5,587	$8,955
10	120 VAC power & signal	4						98	$4,490	$7,449	$11,940
10	Screw conveyor-18" Ø x 20'-CS	2	$43,000	38	$2,143	$1,325	$3,468				
10	480 VAC power	2						55	$2,526	$4,190	$6,716
10	120 VAC signal	2						31	$1,403	$2,328	$3,731
10	Discharge diverter chute assembly-CS	2	$3,000	11	$643	$397	$1,040				
10	Inclined screw conveyor-18" Ø x 50'-CS	1	$41,500	30	$1,714	$1,060	$2,774				
10	480 VAC power	1						31	$1,403	$2,328	$3,731
10	120 VAC signal	1						15	$702	$1,164	$1,866
10	Discharge diverter chute assembly-CS	1	$1,500	6	$321	$199	$520				
10	Belt wash CC HC pump-300 gpm @ 100'-CI	2	$11,000	119	$6,777	$11,463	$18,241				
10	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
10	480 VAC power	2						73	$3,368	$5,587	$8,955
10	120 VAC signal	2						31	$1,403	$2,328	$3,731
10	VFD unit (15 hp)	2	$10,000					37	$1,684	$2,794	$4,477
10	½" seal water solenoid station assembly	2	$700	16	$922	$1,559	$2,480				
10	120 VAC power	2						31	$1,403	$2,328	$3,731
10	4" Ø magnetic flowmeter FIT	2	$5,000	21	$1,179	$729	$1,907				
10	120 VAC power & signal feeds	2						49	$2,245	$3,725	$5,970
10	Motorized BFV-4" Ø-CI (feeds & flushes)	4	$16,000	45	$2,572	$1,590	$4,161				
10	480 VAC power	4						85	$3,929	$6,518	$10,447
10	120 VAC signal	4						61	$2,806	$4,656	$7,462
10	Hopper pad-17.5' x 17'5 (DIVS 2-3)	1		23	$1,301	$2,585	$3,886				
10	Cake hopper-17.5' x 17.5'-painted CS	1	$50,000	66	$3,750	$2,318	$6,068				
10	Tank capacitance LIT	1	$1,600	6	$321	$199	$520				
10	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
10	Discharge knife gates-24"-CS	2	$30,000	128	$7,286	$4,504	$11,790				
10	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
10	Live bottom screw augers-2' Ø x 17.5'-CS	2	$35,000	38	$2,143	$1,325	$3,468				
10	480 VAC power	2						61	$2,806	$4,656	$7,462
10	120 VAC signal	2						31	$1,403	$2,328	$3,731
10	Discharge diverter chute assembly-CS	2	$3,000	11	$643	$397	$1,040				
	EQ & Installation Sheet 5 Totals		**$826,500**	1,668	$94,975	$138,399	**$233,374**	1,224	$56,269	$93,351	**$149,620**

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DIVS 11-17 Equipment & Installation

			DIVS 11-17 Equipment	DIV 15-Mechanical Installation (including applicable allowances)				DIV 16-Electrical Installation (including applicable allowances)			
#	Equipment Item Description	Qty	BARE TOTAL	MH	MH $	M&E	BARE TOTAL	MH	MH $	M&E	BARE TOTAL
10	Neat polymer dilution/feed units-4 gph neat	2	$15,000	129	$7,372	$12,471	$19,843				
10	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
10	Neat polymer tote-4' Ø x 4'-330 gal-HDPE	1	$1,500	42	$2,396	$4,053	$6,449				
10	Hi/Lo float level switch assembly	1	$350	6	$369	$624	$992	9	$401	$665	$1,066
10	Eyewash/shower station	1	$850	13	$737	$1,247	$1,984				
10	120 VAC flow switch	1		5	$276	$468	$744	7	$301	$499	$800
10	Water tempering unit	1	$650	14	$776	$1,239	$2,015				
10	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
10	Bridge drive/hoist assembly-2 ton (DIV 5)	1	$30,000	75	$4,286	$2,649	$6,935				
10	480 VAC power	1						27	$1,263	$2,095	$3,358
10	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
	Plant Drain Pump Station										
11	Structure-10' x 10' x 23' (DIVS 2-3)	1		76	$4,338	$8,617	$12,955				
11	Ultrasonic level LIT (scum pits)	2	$3,200	23	$1,286	$795	$2,081				
11	120 VAC power & signal	2						49	$2,245	$3,725	$5,970
11	Hi/Lo float safety level switch assembly	2	$700	13	$737	$1,247	$1,984	17	$802	$1,330	$2,132
11	Slide rail pumps-440 gpm @ 60'-CI	2	$13,000	123	$7,004	$11,847	$18,851				
11	480 VAC power	2						67	$3,087	$5,122	$8,209
11	120 VAC signal	2						31	$1,403	$2,328	$3,731
11	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
	Odor Control										
12	Paxton PS biofilter area-24' x 12' (DIVS 2-3)	1		79	$4,483	$8,904	$13,387				
12	Biofilter organic media (DIV 15)	1	$1,200								
12	600 cfm centrifugal fans	2	$6,000	41	$2,346	$3,968	$6,314				
12	480 VAC power	2						55	$2,526	$4,190	$6,716
12	VFD unit (2 hp)	2	$5,000					37	$1,684	$2,794	$4,477
12	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
12	Main air header insertion flowmeter FIT	1	$4,500	14	$804	$497	$1,300				
12	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
12	Removable wall assemblies-LF	60	$2,100								
12	WRF biofilter area-36' x 32' (DIVS 2-3)	1		142	$8,098	$16,084	$24,182				
12	Biofilter organic media (DIV 15)	1	$2,000								
12	1100 cfm centrifugal fans	2	$10,400	55	$3,128	$5,291	$8,419				
12	480 VAC power	2						73	$3,368	$5,587	$8,955
12	VFD unit (15 hp)	2	$10,000					37	$1,684	$2,794	$4,477
12	Discharge PS/PI assembly	2	$1,500	10	$553	$935	$1,488	13	$601	$998	$1,599
12	Main air header insertion flowmeter FIT	1	$4,500	14	$804	$497	$1,300				
12	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
12	Removable wall assemblies-LF	100	$3,500								
	Operations Building										
13	Building-42' x 35' (DIVS 2,3,13)	1		104	$5,898	$9,977	$15,874	140	$6,415	$10,642	$17,057
13	Work area canopy-43' x 17' (DIVS 2,3,13)	1		39	$2,212	$3,741	$5,953	52	$2,406	$3,991	$6,396
13	Bridge drive/hoist assembly-2 ton (DIV 5)	1	$30,000	75	$4,286	$2,649	$6,935				
13	480 VAC power	1						27	$1,263	$2,095	$3,358
13	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
	EQ & Installation Sheet 6 Totals		**$148,950**	1,112	$63,294	$99,669	**$162,964**	838	$38,508	$63,886	**$102,394**

MWH CONSTRUCTORS

DIVS 11-17 (Equipment & Installation) - Class 4 OPCC

Project Name	Location	Estimator	Date	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	Jim Ward	29-Sep-08	001	7012451

DIVS 11-17 Equipment & Installation

			DIVS 11-17 Equipment	DIV 15-Mechanical Installation (including applicable allowances)				DIV 16-Electrical Installation (including applicable allowances)			
#	Equipment Item Description	Qty	BARE TOTAL	MH	MH $	M&E	BARE TOTAL	MH	MH $	M&E	BARE TOTAL
13	Eyewash/shower station (work area)	1	$850	13	$737	$1,247	$1,984				
13	120 VAC flow switch	1		5	$276	$468	$744	7	$301	$499	$800
13	Water tempering unit	1	$650	14	$776	$1,239	$2,015				
13	120 VAC power & signal	1						24	$1,123	$1,862	$2,985
13	Laboratory casework/built-ins allowance	1	$25,000	49	$2,765	$4,676	$7,441	65	$3,007	$4,988	$7,995
13	Laboratory equipment/supplies allowance	1	$5,000	6	$321	$199	$520				
13	Office furniture & equipment allowance	1	$10,000	19	$1,106	$1,871	$2,976	26	$1,203	$1,995	$3,198
13	Shop tools & equipment allowance	1	$15,000	19	$1,106	$1,871	$2,976	26	$1,203	$1,995	$3,198
	Power Distribution										
14	Slab for gear & gen-75' x 20' (DIVS 2-3)	1		32	$1,843	$3,118	$4,961	44	$2,005	$3,326	$5,330
14	1300 kW diesel gen/enclose/ATS package	1	$395,000	240	$13,639	$15,100	$28,739	323	$14,834	$24,610	$39,444
14	MCC tie allowances for generator	5									
14	5k gal 2x wall diesel tank/fill station package	1	$18,500	51	$2,910	$4,646	$7,556				
14	120 VAC power	1						24	$1,123	$1,862	$2,985
14	120 VAC signal	1						15	$702	$1,164	$1,866
	EQ & Installation Sheet 7 Totals		**$470,000**	448	$25,480	$34,435	**$59,914**	555	$25,498	$42,302	**$67,801**

MWH CONSTRUCTORS

DIV 13 (Special) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIV 13

Scope Clarifications

PE Steel Building Structures		*Typical: Tank SG Design*	
PE Steel Building Services		*Typical: Tank Freeboard*	
PE Steel Canopy & Roof Structures	Galv CS Structure/Kynar Panels	*Typical: Tank Cone Angle*	
PE Steel Canopy & Roof Services	Vents, Lighting, & Fire Protect	*Welded Tank: Material*	
Mezzanines & Elevated Floors		*Welded Tank: Components*	
Masonry Room & Building Structures	Building & Flat Built-Up Roof	*Welded Tank: Overflow*	
Masonry Room & Building Services	Varies by Structure	*Welded Tank: Int Finish*	
Masonry Unit: Scope	10" CMU w/ Split Face (1)	*Welded Tank: Ext Finish*	
Masonry Unit: Cell Treatment	Rebar & Concrete-Fill (>80%)	*Bolted Tank: Material*	
Typical: Building Interior Finishes	Varies by Structure	*Bolted Tank: Components*	
Typical: Building Architecture	Minimum Enhancement	*Bolted Tank: Overflow*	
Typical: Building Specialty Spaces	Varies by Structure	*(un-assigned)*	

DIV 13 Special Construction Scope

PE Steel Building Structures

#	Name or Location	Qty	Type	Long	Wide	Eave Ht	SF	Tons	MH	MH @ $0	M&E	BARE TOTAL
	(building ID)	0	0.00	0	0	0						
	HV-Lights-Fire Protect NR	0	0.00	1.00								
	(building ID)	0	0.00	0	0	0						
	HV-Lights-Fire Protect NR	0	0.00	1.00								
	Subtotal - PE Steel Building Structures											

PE Steel Canopy & Roof Structures

#	Name or Location	Qty	Type	Long	Wide	Eave Ht	SF	Tons	MH	MH @ $50	M&E	BARE TOTAL
7	UV area canopy	1	1.45	81	15	10	1,215	10.9	112	$5,245	$28,858	$34,104
7	Vents-Lights-Fire Protect	1	2.10						211	$10,839	$8,704	$19,544
13	Ops bldg work area canopy	1	1.45	43	17	18	731	6.5	72	$3,382	$20,971	$24,353
13	Vents-Lights-Fire Protect	1	2.10						133	$6,835	$5,488	$12,323
	(canopy/roof ID)	0	0.00	0	0	0						
	Vents-Lights-Fire Protect NR	0	0.00									
	Subtotal - PE Steel Canopy & Roof Structures						1,946	17.4 tons	527	$26,301	$64,022	**$90,323**

Mezzanine & Elevated Floor Structures

#	Name or Location	Qty	Type	Long	Wide	High	SF	Tons	MH	MH @ $0	M&E	BARE TOTAL
	(mezz/ floor ID)	0	0.00	0	0	0						
	(mezz/ floor ID)	0	0.00	0	0	0						
	(mezz/ floor ID)	0	0.00	0	0	0						
	Subtotal - Mezzanine & Elevated Floor Structures											

Masonry Room & Building Structures

#	Name or Location	Qty	Type	Long	Wide	Eave Ht	SF		MH	MH @ $48	M&E	BARE TOTAL
1	Paxton PS bldg	1	3.50	45	15	15	675		612	$26,357	$58,600	$84,957
1	HV-Part AC-Lights-Fire Prote	1	2.24	2.25					677	$34,844	$25,364	$60,208
10	Sludge dewatering bldg	1	3.53	56	52	18	2,912		1,681	$72,428	$193,718	$266,145
10	HV-Light-Fire Protect	1	2.34	2.56					2,866	$147,454	$111,429	$258,882
13	Ops bldg	1	3.80	40	33	12	1,320		1,102	$47,451	$128,982	$176,433
13	HVAC-Lights-Fire Protect	1	2.63	4.00					1,527	$78,597	$57,814	$136,410
	(bldg/room ID)	0	0.00	0	0	0						
	HVAC-Lights-Fire Protect NR	0	0.00	1.00								
	Subtotal - Masonry Room & Building Structures						4,907		8,465	$407,130	$575,907	**$983,037**

MWH CONSTRUCTORS

DIV 13 (Special) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Welded Circular Tank Structure

#	Name or Location	Qty	Type	Ø	High	Fin-Deg	SG	Gallons	MH	MH @ $0	M&E	BARE TOTAL
	(tank ID)	0	0.0	0	0	0.00	0.00					
	Top & Bottom NR	0	0.0									
	Overflow Trough NR	0	0.0	0	0	0						
	(tank ID)	0	0.0	0	0	0.00	0.00					
	Top & Bottom NR	0	0.0									
	Overflow Trough NR	0	0.0	0	0	0						
	Subtotal - Welded Circular Tank Structures											

Bolted Circular Tank Structure

#	Name or Location	Qty	Type	Ø	High	SF-Fin	Gallons	MH	MH @ $0	M&E	BARE TOTAL
	(tank ID)	0	0.0	0	0						
	Top & Bottom NR	0	0.0								
	Overflow Trough NR	0	0.0	0	0	0.00					
	(tank ID)	0	0.0	0	0						
	Top & Bottom NR	0	0.0								
	Overflow Trough NR	0	0.0	0	0	0.00					
	Subtotal - Bolted Circular Tank Structures										

DIV 13 Special Construction Totals

	MH	MH @ $48	M&E	BARE TOTAL
DIV 13 Totals	8,992	$433,431	$639,928	**$1,073,359**

MWH CONSTRUCTORS

DIV 15 (Mechanical) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIV 15

Scope Clarifications

Pipe Installation Code		*Site: Ventilation Distribution*	Remote Pick-Ups (odor)
Pipe Insulation Materials		*Site: Potable Water System*	Safety Showers & Drinking
Pipe Coating Material	Enamel or Acrylic Pipe Paint	*Site: Process Waste System*	Drainage/Collection System
Vent Ductwork Material	316 SS Ductwork & Fittings	*Site: Sanitary Waste System*	Drainage/Collection System
Pre-Startup Labor	Two (2) Craftsmen-Fulltime	*Internals: Distributor Type*	
Tag & Label Material	Both Plastic & Stainless Steel	*Internals: Media Type*	
Site: Fire Water System	Sprinkler System Feed (SF)	*Internals: Support Type*	
Site: Utility Water System	1" Ø Seal Water Supply (SW)	*Tank Insulation: Material*	
Site: Gas/Air Distribution	½" Ø Standpipe Stations (SS)	*Tank Insulation: Jacketing*	
Site: Chemical Distribution	Remote Fill & Supply	*Tank Insulation: Heat Trace*	

Piping System Material Selection

Selection	*Description*	*Percent*	*Selection*	*Description*	*Percent*
1	DI-Flanged & MJ	65	*3*	Sch 40 Galv Stl-Thread	10
2	Sch 40 Steel-Weld	20	*4*	Sch 10 316 SS-Weld	5

DIV 15 Mechanical Installation Scope

Process & Equipment Installation

#	Description	Qty	Type	%	MH	MH @ $57	M&E	BARE TOTAL
	Rigging & Setting Allowance	1	1.00		2,806	$159,743	$110,149	$269,892
	Piping Allowance	1	1.00		4,523	$257,522	$559,456	$816,979
	Pipe Insulation NR	0	0.00	0%				
	Pipe Coating Allowance	1	1.20	45%	830	$47,281	$24,384	$71,665
	Local Dynamic Vent Allowance	5	6.00		414	$23,586	$56,875	$80,461
	Local Static Ventilation NR	0	0.00					
	Miscellaneous Work NR	0						
	Demolition Work NR	0						
	Pre-Startup Allowance	1	2.00		523	$29,802	$3,360	$33,162
	Tag & Label Allowance	1			132	$7,544	$1,680	$9,224
	Subtotal - Process & Equipment Installation				9,230	$525,479	$755,904	**$1,281,383**

Site Installation Allowances

#	Description	Qty	Type	MH	MH @ $57	M&E	BARE TOTAL
15	Fire Water System	1	1.0	258	$14,700	$11,168	$25,868
15	Utility Water System	1	1.1	404	$23,003	$17,327	$40,329
15	Gas/Air Distribution	1	1.0	96	$5,477	$4,250	$9,727
15	Chemical Distribution	1	1.9	484	$27,562	$20,940	$48,502
15	Ventilation Distribution	1	1.0	105	$5,994	$4,367	$10,361
15	Potable Water System	1	1.1	145	$8,241	$6,417	$14,659
15	Process Waste System	1	1.0	311	$17,697	$13,101	$30,798
15	Sanitary Waste System	1	1.0	92	$5,245	$4,134	$9,378
	Subtotal - Site Installation Allowances			1,895	$107,917	$81,705	**$189,622**

Installation of Internal Assemblies

#	Name or Location	Qty	Type	Long	Ø-Wd	Deep	SF	CF	MH	MH @ $57	M&E	BARE TOTAL
6	Filter air distributors	6	0.75	14.0	14.0		1,176		245	$13,940	$1,490	$15,429
	(air distributor ID)	0	0.00	0.0	0.0							
6	Filter liquid distributors	6	0.75	14.0	14.0		1,176		245	$13,940	$1,490	$15,429
	(liquid distributor ID)	0	0.00	0.0	0.0							
6	Filter media	6	2.50	14.0	14.0	3.3		3,881	338	$19,218	$3,935	$23,153
12	Paxton biofilter media	1	1.00	17.0	17.0	4.0		1,156	33	$1,903	$390	$2,293
12	WRF biofilter media	1	1.00	23.0	23.0	4.0		2,116	61	$3,467	$710	$4,177

MWH CONSTRUCTORS

DIV 15 (Mechanical) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

	(media ID)	0	0.00	0.0	0.0	0.0						
6	Filter media support	6	0.75	14.0	14.0			1,176	305	$17,364	$2,950	$20,313
	(media support ID)	0	0.00	0.0	0.0							
	Subtotal - Installation of Internal Assemblies								1,227	$69,831	$10,964	**$80,795**

Fabrication & Installation of Pipe Headers

#	Name or Location	Qty	Outlet	Tnk Ø	Tnk Dp	Pipe	Coat	GPM-CFM	MH	MH @ $0	M&E	BARE TOTAL
	(liquid distributor ID)	0	0	0	0	0	0					
	(steam distributor)	0	0	0	0	0						
	(air distributor ID)	0	0	0	0	0	0					
	Subtotal - Fabrication & Installation of Pipe Headers											

Installation of Tank Insulation

#	Name or Location	Qty	Type	Long	Ø-Wd	Hi-Dp	T-B	SF	MH	MH @ $0	M&E	BARE TOTAL
	(tank ID)	0	0.0	0	0	0	0					
	(tank ID)	0	0.0	0	0	0	0					
	(tank ID)	0	0.0	0	0	0	0					
	(tank ID)	0	0.0	0	0	0	0					
	(tank ID)	0	0.0	0	0	0	0					
	Subtotal - Installation of Tank Insulation											

DIV 15 Mechanical Totals

	MH	MH @ $57	M&E	BARE TOTAL
DIV 15 Totals	12,352	$703,227	$848,573	**$1,551,800**

MWH CONSTRUCTORS

DIVS 16-17 (Electrical) - Class 4 OPCC

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

Basis of DIVS 16-17

Scope Clarifications

Field Switches Required	HOA (motors & control valves)	*Typical: Motor Efficiency*	80% (average)
Hardware to be Installed	All Electrical Equipment Installed	*Typical: Power Factor*	0.80 (anticipated)
Ground System Scope	Combined Cad-Weld/Raceway	*Option: Controls Location*	Centralized
Piping Heat Trace Load		*Option: Equipment Procure*	Remote (to site) Vendor
Building Service Load	Building Services @ 15 W/SF	*Option: Equipment Design*	By Supplying Vendor
Canopy/Roof Service Load	Roof Lighting @ 4 W/SF (20 FC)	*Option: 3Ø Walk-In Gear*	Low Voltage Gear (480 V)
Pre-Startup Labor	Two (2) Craftsmen-Fulltime	*3Ø Low-VAC Gear Level*	480 VAC
Tag & Label Material	Both Plastic & Stainless Steel	*3Ø Low-VAC Gear Rating*	MCC - NEMA 1G (Std)
Site: Outdoor Light System	Pole-16' Aluminum-400 W	*3Ø Med-VAC Gear Level*	
Site: Utility Power System	Convenience Outlets	*3Ø Med-VAC Gear Rating*	
Site: Fire & Alarm System	Detection & Local/Remote Alarm	*1Ø Process Controls Level*	120 VAC
Site: Security System	Site-Entry & Surveil	*1Ø Process Controls Rating*	NEMA 12 (Std)
Site: Telecom System	Phone/IC, Comp Net, & RTU	*1Ø PLC Type & Rating*	SCADA - NEMA 12 (Std)

Raceway System Material Selection

Selection	*Description*	*Percent*	*Selection*	*Description*	*Percent*
1	PVC-Coated RGS	75	*# 3*	RGS-Class I/Division II	5
2	Galv Steel Conduit-RGS	15	*# 4*	In-Slab Sch 80 PVC	5

DIV 16 Electrical Installation Scope

Process & Equipment Installation

#	Description	Qty	Type	%	MH	MH @ $46	M&E	BARE TOTAL
	Raceway & Wiring Allowance	1	1.00		8,326	$382,805	$710,196	$1,093,001
	Grounding Allowance	1			842	$38,691	$43,862	$82,553
	Pipe Heat Tracing NR	0	0.00	0%				
	Miscellaneous Work NR	0						
	Demolition Work NR	0						
	Pre-Startup Allowance	1	2.00		632	$29,059	$3,749	$32,808
	Tag & Label Allowance	1			160	$7,355	$1,875	$9,230
	Subtotal - Process & Equipment Installation				9,959	$457,910	$759,682	**$1,217,592**

Site Installation Allowances

#	Description	Qty	Type	MH	MH @ $46	M&E	BARE TOTAL
15	PS-400W 16' alum light poles	2	8.0	147	$6,759	$8,535	$15,294
15	WRF-400W 16' alum light poles	10	8.0	735	$33,797	$42,673	$76,470
15	Utility Power System	1	1.0	811	$37,309	$6,268	$43,577
15	Fire/Process Alarm System	1	1.6	378	$17,362	$23,550	$40,912
15	Security System	1	2.5	1,029	$47,295	$65,670	$112,965
15	Telecom System	1	2.3	373	$17,156	$28,287	$45,443
	Subtotal - Site Installation Allowances			3,473	$159,678	$174,982	**$334,660**

DIVS 16-17 Electrical Gear & Controls Scope

DIV 16 Power Distribution & Control Equipment - 480 VAC Motor Control Center (MCC) Package

#	Package Components	Qty	Component	Load Data & BARE TOTAL
	Indoor (coated steel) 480V Motor Control Center (MCC) - 22 Sections (37 LF)	1	$325,895	*Connected HP = 196*
	Variable Speed Drive Unit Allowance NR	0		*Connected KW = 2980*
	Stepdown Transformer(s) & Support Equipment Allowance (681 KVA)	1	$17,300	*Connected FLA = 4479*
	Metering & Monitoring EquipmentAllowance	1	$5,039	*Generator KW = 2530*
	Miscellaneous Upgrades Allowance	1	$4,759	
	Subtotal - 480 VAC MCC Package			**$352,993**

DIVS 16-17 (Electrical) - Class 4 OPCC

MWH CONSTRUCTORS

Project Name	Location	Date	Estimator	Version	Project #
Hi-Desert Water District WRF	Yucca Valley, CA	29-Sep-08	Jim Ward	001	7012451

DIV 16 Power Distribution & Control Equipment - 4160 VAC Gear Package

#	Package Components	Qty	Component	Load Data & BARE TOTAL
	4160V Enclosure & Components Allowance NR	0		
	Variable Speed Drive Unit Allowance NR	0		
	Stepdown Transformer(s) & Support Equipment NR	0		
	Metering & Monitoring Equipment NR	0		
	Miscellaneous Upgrades Allowance NR	0		
	Subtotal - 4160 VAC Gear Package			

DIV 17 Process Control Equipment - 120 VAC Electrical Control Panel (MCP) Package

#	Package Components	Qty	Component	BARE TOTAL
	ECP Control Components Allowance	1	$69,100	
	Assembly & Testing Labor Allowance	1	$22,000	
	Indoor (coated steel) Enclosure Allowance - 5 doors (15 LF)	1	$4,200	
	Engineering & Design Labor Allowance	1	$63,300	
	Miscellaneous Upgrades Allowance	1	$3,455	
	Subtotal - 120 VAC MCP Package			**$162,055**

DIV 17 Process Control Equipment - 120 VAC SCADA System Package

#	Package Components	Qty	Component	BARE TOTAL
	Control System Components, HMI, & Software Allowance	1	$240,700	
	Assembly & Testing Labor Allowance	1	$57,800	
	Indoor (coated steel) Enclosure Allowance - 5 doors (0 LF)	1	$4,200	
	Engineering, Design, & Programming Labor Allowance	1	$171,000	
	Miscellaneous Upgrades Allowance	1	$12,035	
	Subtotal - 120 VAC SCADA Package			**$485,735**

DIVS 16-17 Electrical Totals

	MH	MH @ $46	M&E	BARE TOTAL
DIVS 16-17 Totals	13,432	$617,589	$934,664	**$2,553,035**